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For related information see also *Astronautics.*

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Includes magnetohydrodynamics and plasma fusion.
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76 SOLID-STATE PHYSICS 1105
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1109
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1110
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1111
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 1112
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1112
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 1114

89 ASTRONOMY 1121
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1122
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1124
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1125
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1126
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 1126

Note: N.A. means that no abstracts were assigned to this category for this issue.

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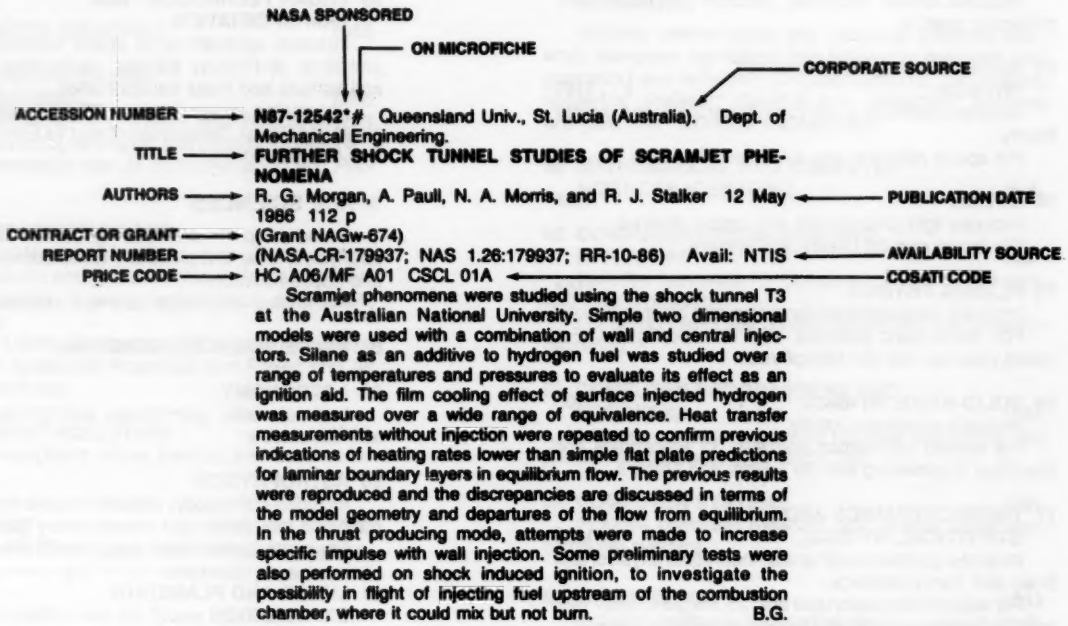
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CORPORATE SOURCE
ACCESSION NUMBER
N87-12542*# Queensland Univ., St. Lucia (Australia). Dept. of Mechanical Engineering.
TITLE
FURTHER SHOCK TUNNEL STUDIES OF SCRAMJET PHENOMENA
AUTHORS
R. G. Morgan, A. Paull, N. A. Morris, and R. J. Stalker 12 May 1986 112 p
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAGw-674)
REPORT NUMBER
(NASA-CR-179937; NAS 1.26:179937; RR-10-86) Avail: NTIS
AVAILABILITY SOURCE
PRICE CODE
HC A06/MF A01 CSCL 01A
COSATI CODE
Scramjet phenomena were studied using the shock tunnel T3 at the Australian National University. Simple two dimensional models were used with a combination of wall and central injectors. Silane as an additive to hydrogen fuel was studied over a range of temperatures and pressures to evaluate its effect as an ignition aid. The film cooling effect of surface injected hydrogen was measured over a wide range of equivalence. Heat transfer measurements without injection were repeated to confirm previous indications of heating rates lower than simple flat plate predictions for laminar boundary layers in equilibrium flow. The previous results were reproduced and the discrepancies are discussed in terms of the model geometry and departures of the flow from equilibrium. In the thrust producing mode, attempts were made to increase specific impulse with wall injection. Some preliminary tests were also performed on shock induced ignition, to investigate the possibility in flight of injecting fuel upstream of the combustion chamber, where it could mix but not burn. B.G.

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N87-15932*# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
JET ENGINE SIMULATION WITH WATER INGESTION THROUGH COMPRESSOR Final Report

T. Haykin and S. N. B. Murthy Jan. 1987 172 p
(Grant NAG3-481; Contract DTFA03-83-A00328)
(NASA-CR-179549; NAS 1.26:179549; FAA/CT-TN87/1; M/NAFA/TR-1) Avail: NTIS HC A08/MF A01 CSCL 21E

Water ingestion into a jet engine affects most directly the performance of the air compression subsystem of the engine, and also the sensors located in that subsystem providing input to the engine's control system. Such performance changes affect the overall performance of the engine. Considering a generic, high bypass ratio, two-spool gas turbine operating on a stationary test stand with fixed inlet and thrustor nozzle, an attempt was made to establish the transient performance of the engine under a variety of water ingestion and power setting conditions and also when a temperature sensor providing input to the engine control records a lower temperature than the local gas phase temperature. The principal tools utilized in the investigation have been the so called PURDUE code and an engine simulation code. Performance calculations in each selected case have been made under two limiting sets of conditions: (1) total drainage of water, and (2) partial evaporation of water at the entry or exit of the burner with remaining water drained. Although the results are specialized to the generic engine and its control, it is shown in general that: (1) engine performance is degraded during operation with water ingestion and the amount of degradation is a nonlinear function of inlet water mass fraction; (2) controllability of the engine with respect to operator-initiated power setting changes is affected by water ingestion; and (3) errors in a temperature sensor providing an input to engine control lead to instability in engine operation, eventually causing a limiting condition or parameter to be exceeded. Author

N87-15933# Naval Postgraduate School, Monterey, Calif.
AN ANALYSIS OF THE COST-VOLUME RELATIONSHIPS WITHIN THE AIRCRAFT PROGRAM OF THE NAVAL AIR REWORK FACILITY, ALAMEDA, CALIFORNIA M.S. Thesis
Robert L. Ferriman Jun. 1986 128 p
(AD-A171729) Avail: NTIS HC A07/MF A01 CSCL 14/1

The purpose of this research project is to examine the cost behavior of the Naval Air Rework Facility, Alameda, California, aircraft program in relation to variations in aircraft rework workloads, and to develop cost-volume relationships useable in support of pricing and workload decisions. Analysis of four years of quarterly direct and indirect cost data provided the base from which total cost-volume models were derived for the four aircraft program segments (A-6, P-3, S-3 and A-3). The results of this study indicate that significant cost-volume relationships exist not only with direct costs but also with many associated indirect aircraft program costs. The study further suggests that other factors, such as rate and direction of volume changes and levels of personnel strengths, may have predictable affects on aircraft rework costs. GRA

N87-15934# Joint Publications Research Service, Arlington, Va.
JAPAN REPORT: SCIENCE AND TECHNOLOGY
7 Jan. 1987 122 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-87-001) Avail: NTIS HC A06/MF A01

Science and technology topics addressed include: aerospace sciences; biotechnology; energy technology; metallurgical industry; nuclear development; science and technology; and robotics. For individual titles, see N87-15935 through N87-15938.

N87-15935# Joint Publications Research Service, Arlington, Va.
DEVELOPMENTS IN STOL AIRCRAFT REPORTED **c02**
In its Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 1-3 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 1-2 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

Wind tunnel tests for the Asuka were performed by using a transonic wind tunnel 2 x 2 m from late May to early June. The main purposes of the tests are as follows: to obtain basic aerodynamic data for expanding the flight area to the high-speed side at flight experiments on the Asuka; and to establish technologies necessary for performing tests on a power model in a transonic wind tunnel. B.G.

N87-15936# Joint Publications Research Service, Arlington, Va.
OPTICAL TRANSDUCER: STOL AIRCRAFT **c08**
In its Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 3-5 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 2-3 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

Research on the FBL (fly by light) is being conducted as a part of the research on future technology for STOL aircraft. This FBL is used to optically transmit signals emitted from control systems. The main features of the experimental optical transducer are described. Environmental resistance tests, functional tests, and performance tests are scheduled to be conducted for the optical transducer unit by using a rig testing unit and an experimental aircraft. B.G.

N87-15937# Joint Publications Research Service, Arlington, Va.
LOW-GRAVITY USE AIRCRAFT **c05**
Heihachiroh Hemura *In its* Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 6-8 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 5-7 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

The Science and Technology Agency (STA) conducted research with the aim of establishing the basic technology necessary

for inventing new materials. Experiments conducted in a low-gravity environment are summarized. B.G.

N87-15938# Joint Publications Research Service, Arlington, Va.
APPLICATIONS OF INDUSTRIAL ROBOTS TO MACHINING DISCUSSED **c37**
Kanji Yoneyama *In its* Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 91-97 Transl. into ENGLISH from Kikai to Kogu (Tokyo, Japan), May 1986 p 17-25 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

The trends of demand and applications of machining robots are briefly described. The availability of industrial robots in the machining sector will increase and their role will be greater along with the progress in flexible manufacturing systems (FMSs) and diffusion of unmanned plants. B.G.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N87-15939 Brown Univ., Providence, R. I.
SUPERSONIC FLOW OVER AXISYMMETRIC AND NON-AXISYMMETRIC BODIES Ph.D. Thesis
Jefferson Fong 1986 78 p
Avail: Univ. Microfilms Order No. DA8617558

A method based on streamlines, characteristics, and Riemann functions is introduced for supersonic inviscid flow over axisymmetric and nonaxisymmetric bodies. Starting from a simple approximation, an iterative procedure is developed which converges rapidly to the exact solution. The scheme is both body fit and shock fit. As a result the procedure is computationally efficient, inherently accurate, and requires relatively few points to calculate the entire flow field. Both the direct and inverse design problem are treated. For a thin axisymmetric body traveling at a low Mach number, our results show the presence of a pressure minimum on the body, which in turn implies flow separation. For flow over nonaxisymmetric bodies, using the near characteristics method, an iterative procedure is developed which converges rapidly to the exact solution. Also in this case, relative few points are required to compute the entire flow field. Dissert. Abstr.

N87-15940 ESDU International Ltd., London (England).
NORMAL-FORCE CURVE SLOPE AND CENTRE OF PRESSURE POSITION AT ZERO ANGLE OF ATTACK FOR TANGENT-OGIVE CYLINDER AND CONE-CYLINDER COMBINATIONS AT SUPERSONIC SPEEDS
Nov. 1986 16 p
(ESDU-86029; ISBN-0-85679-581-X; ISSN-0141-397X) Avail: ESDU

ESDU 86029 provides an estimation method for normal-force curve slope and center of pressure position at zero angle of attack for a wide range of tangent-ogive cylinder and cone cylinder bodies. The data are presented in carpet form in terms of parameters involving Mach number, forebody fineness ratio and cylinder fineness ratio and are experimental in origin. The data are suitable for stability calculations involving small perturbations and may also be used for the direct prediction of normal force and center of pressure position at low angles of attack. Full details of the applicability and accuracy of the Item are provided, together with an illustration of its use by means of a worked example. ESDU

N87-15941*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF THEORETICAL AND FLIGHT-MEASURED LOCAL FLOW AERODYNAMICS FOR A LOW-ASPECT-RATIO FIN
J. Blair Johnson and Doral R. Sandlin (California Polytechnic State Univ., San Luis Obispo) Dec. 1986 21 p
(Contract NCC-4-1)
(NASA-TM-86806; H-1336; NAS 1.15:86806) Avail: NTIS HC A02/MF A01 CSCL 01A

Flight test and theoretical aerodynamic data were obtained for a flight test fixture mounted on the underside of an F-104G aircraft. The theoretical data were generated using two codes: a two-dimensional transonic code called code H, and a three-dimensional subsonic and supersonic code called wing-body. Pressure distributions generated by the codes for the flight test fixture, as well as compared with the flight-measured data. The two-dimensional code pressure distributions compared well except at the minimum pressure point and the trailing edge. Shock locations compared well except at high transonic speeds. However, the two-dimensional code did not adequately predict the displacement thickness of the flight test fixture. The three-dimensional code pressure distributions compared well except at the trailing edge of the flight test fixture. Author

N87-15942# Air Force Armament Lab., Eglin AFB, Fla.
UNSTEADY 3-DIMENSIONAL EULER EQUATIONS SOLUTIONS ON DYNAMIC BLOCKED GRIDS Final Technical Report, Oct. 1985 - Sep. 1986
Dave M. Belk Oct. 1986 164 p
(AD-A173977; AFATL-TR-86-74) Avail: NTIS HC A08/MF A01 CSCL 01/2

An unsteady implicit Euler equation solution algorithm using finite volume discretization and flux-vector splitting is presented. The effect on time-accuracy of different time step sizes, different approximate factorizations, and formal first-order versus second-order time accuracy is determined by numerical experimentation on a NACA0012 airfoil undergoing pitch oscillations in transonic flow. It is shown that time step sizes corresponding to Courant numbers of 100 or more can produce time-accurate results if flow variables are not rapidly changing. Due to better stability properties, the two-factor method gives better results than the six-factor method. Also, the second-order-time-accurate three point backward time discretization is shown to yield only slight improvement over the first-order-time-accurate backward Euler time discretization. Methods of obtaining time-accurate Euler solutions on blocked grids are analyzed and verified by comparing multi-block solutions with equivalent one-block solutions. GRA

N87-15943*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REMOTE BOUNDARY CONDITIONS FOR UNSTEADY MULTI-DIMENSIONAL AERODYNAMIC COMPUTATIONS Final Report
Philip L. Roe Nov. 1986 27 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178211; ICASE-86-75; NAS 1.26:178211) Avail: NTIS HC A03/MF A01 CSCL 01A

The behavior of gas dynamic flows which are perturbations of a uniform stream in terms of information transfer across artificial (computational) boundaries remote from the source of disturbance are discussed. A set of boundary conditions is derived involving vorticity, entropy, and pressure-velocity relationships derived from bicharacteristic equations. Author

N87-15944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A METHOD FOR CALCULATING TURBULENT BOUNDARY LAYERS AND LOSSES IN THE FLOW CHANNELS OF TURBOMACHINES
Lawrence F. Schumann [1987] 17 p Proposed for presentation at the 32nd International Gas Turbine Conference and Exhibition, Anaheim, Calif., 31 May - 4 Jun. 1987; sponsored by ASME
(NASA-TM-88928; E-3264; NAS 1.15:88928; USAAVSCOM-TR-86-C-36) Avail: NTIS HC A02/MF A01 CSCL 01A

An interactive inviscid core flow-boundary layer method is presented for the calculation of turbomachine channel flows. For this method, a one-dimensional inviscid core flow is assumed. The end-wall and blade surface boundary layers are calculated

using an integral entrainment method. The boundary layers are assumed to be collateral and thus are two-dimensional. The boundary layer equations are written in a streamline coordinate system. The streamwise velocity profiles are approximated by power law profiles. Compressibility is accounted for in the streamwise direction but not in the normal direction. Equations are derived for the special cases of conical and two-dimensional rectangular diffusers. For these cases, the assumptions of a one-dimensional core flow and collateral boundary layers are valid. Results using the method are compared with experiment and good quantitative agreement is obtained. Author

N87-15945# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE BRL-Q1D: A TOOL FOR THE NUMERICAL SIMULATION OF FLOWS IN SHOCK TUBES WITH VARIABLE CROSS-SECTIONAL AREAS Final Report
Klaus O. Opalka and Andrew Mark Oct. 1986 90 p
(AD-A174254; BRL-TR-2763) Avail: NTIS HC A05/MF A01 CSCL 19/4

The BRL-Q1D code is a computer program that uses quasi-one-dimensional, adiabatic, inviscid, numerical algorithms to solve the Euler equations. The governing equations are derived for arbitrary geometry and transformed into a uniform computational grid. An implicit Beam-Warming solver and an explicit MacCormack solver are employed. The input requirements, the code structure and the output options are discussed. Various flow calculations with the BRL-Q1D code are verified against experiments. Calculations are performed using the experimental geometries and test conditions of a conventional shock tube, a small-scale blast-simulator model and the large blast simulator at the experimental data validates the numerical flow simulation. In addition, two methods are discussed which are helpful for improving the computational prediction. GRA

N87-15946# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
ACTIVE FEEDBACK INTERACTION WITH A SHEAR LAYER Annual Progress Report, Jun. 1985 - Jun. 1986
P. E. Dimotakis and M. M. Koochesfahani 30 Jun. 1986 26 p (Grant AF-AFOSR-0120-84)
(AD-A174544; AFOSR-86-1034TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

Work continues on the characterization of the effects of a pitching airfoil on the shear layer structure and growth under open loop forcing. It is shown that locally introduced disturbances can induce significant changes in the growth of the shear layer mixing zone. A separate investigation into the structure of the wake of an oscillating airfoil in a steady, uniform free stream revealed the existence of an axial flow along the cores of the wake vortices. The magnitude of the axial flow appears to depend on both the frequency and amplitude of oscillation. GRA

N87-15935# Joint Publications Research Service, Arlington, Va.
DEVELOPMENTS IN STOL AIRCRAFT REPORTED
In its Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 1-3 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 1-2 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

N87-16183# Joint Publications Research Service, Arlington, Va.
NUMERICAL ANALYSIS OF HEAT TRANSFER AT SURFACE OF DELTA WING IN HYPERSONIC AIR STREAM WITH LARGE ANGLE OF ATTACK
N. Ye. Afonina, A. Yu. Vlasov, and V. G. Gromov *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 74 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 196-199 Original language document was announced in IAA as A85-16190 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N87-15947# Hughes Associates, Inc., Wheaton, Md.
AFFF (AQUEOUS FILM-FORMING FOAM) TESTING OF US AIR FORCE PENETRATOR NOZZLE Final Report, May - Jul. 1985
Robert C. Beller, Ralph J. Ouellette, Joseph L. Walker, James Calfee, and Phyllis Campbell May 1986 12 p
(Contract N00014-84-C-2200; AF Proj. 2505)
(AD-A171854; AFESC/ESL-TR-86-28) Avail: NTIS HC A02/MF A01 CSCL 13/12

The Skin Penetrator/Agent Application Tool (SPAAT), a new firefighting tool developed for the U.S. Air Force, was tested to determine performance characteristics when using Aqueous Film-Forming Foam (AFFF). The results showed that increasing the nozzle pressure to 150 psi from the more common fireground pressures of 50 or 100 psi provided a significant increase in stream reach, which improved fire-extinguishing capability. However, the resulting foam quality was diminished, but could be improved by aeration, although at some loss in stream reach. GRA

N87-15948# Naval Weapons Center, China Lake, Calif.
IN-FLIGHT EJECTION SEAT TEST USING THE AIRCREW GLIDING ESCAPE SYSTEM (AGES) PARACHUTE Final Report, Oct. 1984 - Aug. 1986
Manley C. Butler, Jr. Sep. 1986 80 p
(AD-A172987; NWC-TP-6741) Avail: NTIS HC A05/MF A01 CSCL 01/3

The objective of the Aircrew Gliding Escape System (AGES) Program is to develop a ram-air-inflated, gliding parachute wing for use in Navy aircrew escape systems. This report describes an in-flight ejection test conducted at the Naval Weapons Center on 23 October 1984 using the AGES parachute canopy in a Stencel SIIIS-3-ER ejection seat. The test was initiated at 500 knots equivalent airspeed (KEAS) at 5000 feet AGL (7500 feet MSL) from the rear seat of the Center's YF-4 aircraft. The riser loads on the dummy were well within acceptable limits, and no damage occurred to the parachute or the seat system (which was recovered by a separate parachute). (U) This report contains complete documentation of the test setup for the seat and parachute. In addition, copies of the test plan, abort criteria, and checklists are included. GRA

N87-15949# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE PSYCHOLOGICAL PROFILE IN AIRCRAFT ACCIDENT INVESTIGATION Ph.D. Thesis
Walter E. Sipes 1986 37 p
(AD-A172977; AFIT/CI/NR-86-170D) Avail: NTIS HC A03/MF A01 CSCL 06/5

Pilot error is consistently cited as a major source of aircraft accidents. There are many types of pilot errors or human factors cited as possible causes contributing to a mishap and can include such areas as attention, learning, memory, intelligence, decision-making, motivation, psychomotor skills, selection, human engineering, ergonomics, and personality. Human factors as evidence in aircraft accidents has been both championed and condemned. This paper will look at yet another tool of human factors with the idea of looking at contributing causes to mishaps, building a database of some of those intangible areas of people, and looking for a profile to predict and prevent future mishaps occurring. This tool is a psychological autopsy/profile. GRA

N87-15950# General Dynamics/Fort Worth, Tex.
EVALUATION OF IMPROVED ENGINE COMPARTMENT OVERHEAT DETECTION TECHNIQUES Final Technical Report, Aug. 1985 - Aug. 1986
R. C. Foster, C. Barker, D. W. Goodwin, V. Rowe, and C. E. Porcher Aug. 1986 177 p
(Contract F33615-85-C-2548)

(AD-A173960; FZM-7415; AFWAL-TR-86-2060) Avail: NTIS HC A09/MF A01 CSCL 21/5

A study was conducted to evaluate the feasibility of utilizing infrared (IR) sensor technology to detect leaks from failed aircraft bleed ducts. Improved overheat detection system requirements were defined and detection concepts were formulated based on these requirements. An IR detection concept was shown to exhibit potential for improvement over other concepts formulated and existing cable type detection elements. A nacelle/bleed duct simulator was designed and fabricated in order to conduct tests of IR detection concepts. Radiation detection instrumentation was designed for utilizing the IR instrumentation and a Systron-Donner element to detect simulated bleed leaks at three different flight conditions. The test data was analyzed to evaluate the feasibility of IR detection techniques and the relative performance of the IR techniques with respect to cable-type elements was determined. GRA

N87-15951# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.

AIRCRAFT ACCIDENT REPORTS. BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 11, 1985 ACCIDENTS

5 Sep. 1986 423 p

(PB86-916925; NTSB-AAB-86-26) Avail: NTIS HC A18/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01C

Selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1985 are given. Approximately 200 General Aviation and Air Carrier accidents represent a random selection. The facts, conditions, circumstances and probable cause(s) for each accident are given. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

N87-15952# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

PHYSICALLY-BASED SIMULATION MODEL FOR ACOUSTIC SENSOR ROBOT NAVIGATION Interim Report

Roman Kuc and M. W. Siegel May 1986 39 p Prepared in cooperation with Yale Univ., New Haven, Conn.

(AD-A171722; CMU-RI-TR-86-11) Avail: NTIS HC A03/MF A01 CSCL 17/7

A computer model is described that combines concepts from the fields of acoustics, linear system theory and digital signal processing to simulate an acoustic sensor navigation system using time-of-flight ranging. By separating the transmitter/receiver into separate components and assuming mirror-like reflectors, closed-form solutions for the reflections from corners, edges and walls are determined as a function of transducer size, location and orientation. A floor plan consisting of corners, walls and edges is efficiently encoded to indicate which of these elements contribute to a particular pulse-echo response. Sonar maps produced by transducers having different resonant frequencies and transmitted pulse waveforms can then be simulated efficiently. Examples of simulated sonar maps of two floor plans illustrate the performance of the model. Actual sonar maps are presented to verify the simulation results. Author (GRA)

N87-15953# Mitre Corp., McLean, Va. Metrek Div.

A PROPOSED SINGLE CRITERION FOR IFR (INSTRUMENT FLIGHT RULES) APPROACHES TO CONVERGING RUNWAYS

William E. Weiss Jul. 1986 81 p

(Contract DTFA01-84-C-0001)

(AD-A171844; MTR-86W17; FAA-DL5-86-2) Avail: NTIS HC A05/MF A01 CSCL 01/5

This document discusses three criteria currently under consideration for operating independent approaches to converging runways under Instrument Flight Rules. These criteria include the Worst-Case Boundaries, developed for the Federal Aviation Administration (FAA) by The MITRE Corporation; the application of nonoverlapping Terminal Instrument Procedures (TERPS) obstacle clearance surfaces to provide protected airspace, developed by the FAA's Air Traffic Operations Service; and Tower-Applied Visual Separation on Missed Approach, currently used in Chicago. A Single Criterion is then proposed which combines elements of the TERPS Criterion and the Worst-Case analysis. This criterion provides explicit blunder protection and its dimensions are functions of measurable navigation performance parameters. However, the decision heights obtained using the Single Criterion are generally higher than those obtained using the TERPS+3 Criterion. This leads to the conclusion that, using the techniques described for the Single Criterion, decision heights lower than those generated by the TERPS+3 Criterion may not be feasible for independent IFR approaches to converging runways. However, the Single Criterion may be useful in the future because it is directly related to aircraft performance on missed approach. Any improvements in navigation and/or aircraft performance can be reflected in this criterion, with a corresponding lowering of decision heights. GRA

N87-15954# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

STUDY OF THE EFFECTS OF VIBRATION ON INERTIAL NAVIGATION SYSTEM ACCURACY M.S. Thesis

Donald J. Kocian Jun. 1986 124 p

(AD-A172420; AFIT/GE/ENG/86J-2) Avail: NTIS HC A06/MF A01 CSCL 17/7

This study examines the effects of airframe vibration on the accuracy of a strapdown inertial navigation system. A stochastic model of the system error equations is included, as are two models of airframe vibration. Software subroutines for model implementation in SOFE are included. A representative C-130A flight profile was developed using a flight trajectory generator, PROFGEN. The system errors induced in the inertial navigation by simulating this mission are included as are those caused by vibration. Vibration induced errors were found to be very small and orders of magnitudes smaller than those caused by other error sources. GRA

N87-15955# Center for Naval Analyses, Arlington, Va. Naval Planning Manpower and Logistics Div.

COMPUTATION OF RANGE AND HEADINGS ALONG GREAT CIRCLE PATHS Final Report

Stuart G. Dunn Mar. 1986 18 p

(Contract N00014-83-C-0725; R01-48)

(AD-A173740; CNA-CRM-86-71) Avail: NTIS HC A02/MF A01 CSCL 17/7

This research memorandum presents formulas for computing range and headings along great circle paths and a FORTRAN subroutine for implementing the formulas. When a great circle path is traveled between two points on the Earth's surface, the heading generally varies in time. Formulas are presented for the initial and final headings on the shortest great circle path between an origin and a destination, whose positions are specified by latitude and longitude. GRA

N87-15956# Arinc Research Corp., Annapolis, Md.

EVALUATION OF ALTERNATIVES FOR ARMY PRECISION LANDING SYSTEM: GROUND GUIDANCE Final Report, 1 Oct. 1985 - 31 Jul. 1986

C. Boyd, J. Gruhler, and R. Lewsen Jul. 1986 61 p

(Contract DAEA18-84-C-0127)

(AD-A174093; Rept-2959-01-2-4106) Avail: NTIS HC A04/MF A01 CSCL 17/7

This report deals with current and planned aircraft guidance

systems as they apply to Army tactical precision landings in the combat environment. Self-contained avionics systems and less sophisticated systems have been evaluated. Ground guidance is defined as a means to safely, efficiently, and rapidly aid in the movement of aircraft from their transition point of landing to a final destination. The study addressed the following four tasks: review army requirements (Ground Guidance) by research of current documentation and by extensive interviews; identify alternative systems through specifications and discussions with government and industrial personnel; evaluate systems by conducting aviator and engineer evaluations; and identify and document best approach for Army use in the tactical environment. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

N87-15957 Stanford Univ., Calif.
DYNAMICS OF A HELICOPTER WITH A SLING LOAD Ph.D. Thesis
Tuvya Ronen 1986 239 p
Avail: Univ. Microfilms Order No. DA8606217

The operations of helicopters carrying externally slung loads are often hampered by stability and control problems. To develop control schemes for alleviating these problems, it is necessary to have a good dynamic model for the helicopter and sling load system. Therefore the goals of this work are to improve the existing dynamic models for single point suspensions, especially in the area of load aerodynamics, and to investigate the open loop characteristics of the system. The model is intended for use in designing control schemes for helicopters with sling loads. The equations of motion (EOM) of the helicopter-load system are derived for a single point suspension. The dynamic model treats both the helicopter and the load as rigid bodies, each subjected to inertial and aerodynamic forces and moments. The formulation is applicable to various types of helicopters, loads, and versions of a single point suspension. The nonlinear EOM are derived first, and then separated into two sets: nonlinear trim equations, and linearized EOM for small perturbation about the equilibrium. The linearized equations are symmetric--the equations for the helicopter and the load are similar, being as close a possible to the standard form of EOM of a single flight vehicle. The dynamic model takes into account the effect of the downwash of the rotor on the dynamics of the load. Momentum theory is used to approximate the downwash and to predict the wake boundaries. Dissert. Abstr.

N87-15958 ESDU International Ltd., London (England).
DESIGN AGAINST FATIGUE; VIBRATION OF STRUCTURES UNDER ACOUSTIC OR AERODYNAMIC EXCITATION
Oct. 1986 38 p
(ESDU-86025; ISBN-0-85679-577-1; ISSN-0141-3961) Avail: ESDU

ESDU 86025 provides guidance on the design of aerospace structures to avoid acoustically or similarly induced fatigue failures. The sources of excitation in an aerospace environment are reviewed. Modes of response and associated types of failure under a fluctuating pressure loading are considered and good detail design practice for typical aerospace structural elements is illustrated. Examples, based on actual case studies, of the use of good detail design to improve structural life are included. Also considered is the design of the support structure when mounting systems and equipment in a high noise environment, and again a variety of examples of good and bad practice is illustrated and discussed. ESDU

N87-15959*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE STATIC INVESTIGATION OF CIRCULATION-CONTROL-WING CONCEPTS APPLIED TO UPPER SURFACE-BLOWING AIRCRAFT
M. D. Shovlin, R. J. Englar (Naval Ship Research and Development Center, Bethesda, Md.), J. C. Eppel, and J. H. Nichols, Jr. Jan. 1987 65 p
(NASA-TP-2684; NAS 1.60:2684) Avail: NTIS HC A04/MF A01 CSCL 01C

The use of a circulation control to deflect turbofan engine thrust beyond 90 deg. has been proven in full-scale static ground tests of the circulation-control-wing/upper-surface-blowing (CCW/USB) concept. This powered high-lift system employs a circular, blown trailing edge to replace the USB mechanical flaps to entrain engine-exhaust flow, and to obtain both a vertical-thrust component and an augmented circulation lift for short takeoff and landing (STOL) applications. Previous tests (Phase 1), done in 1982, of a basic configuration installed on the Quiet Short Haul Research Aircraft confirmed these CCW/USB systems capabilities. A second phase (Phase 2) of full-scale, static, thrust-deflection investigations has reconfirmed the ability to deflect engine thrust from 40 to 102 deg., depending on thrust level. Five new configurations were evaluated and performance improvements noted for those configurations with larger blown span, fences or favorable engine interactions, smaller slot height, and larger radii with less than 180 deg. of CCW surface arc. In general, a 90 deg. circular arc with a smaller slot height provided the best performance, demonstrating that adequate thrust turning can be produced by a trailing-edge shape which may have minimal cruise-performance penalty. Thrust deflections were achieved at considerably lower blowing momentum than was required for the baseline case of Phase 1. Improved performance and versatility were thus confirmed for the CCW/USB system applied to STOL aircraft, where the potential for developing a non-moving-parts pneumatic thrust deflector to rapidly vary horizontal force from thrust to drag, while maintaining constant vertical force, appears quite promising. The conversion from high-lift to lower-drag cruise mode by merely terminating the blowing provides an effective STOL aircraft system. Author

N87-15960# State Univ. of New York, Buffalo. Dept. of Psychology.
POSITIVE-PRESSURE VENTILATOR SYSTEMS AT HIGH ALTITUDE: A PRELIMINARY STUDY Final Report, Jul. 1983 - Mar. 1984
Leon E. Farhi and Daniel A. Whalen, Jr. Jun. 1986 30 p
(Contract F33615-82-D-0627)
(AD-A171647; USAFSAM-Tr-86-2) Avail: NTIS HC A03/MF A01 CSCL 13/1

The USAF Military Airlift Command is charged with air evacuation of injured and ill patients in times of war and peace. In recent years the types of patients eligible for transport have expanded to include those with illnesses or injuries that require full-time mechanical support of respiratory functions with closed-system positive-pressure mechanical ventilators. The clinical condition of some patients meets the criteria of the Adult Respiratory Distress Syndrome, which is characterized by low pulmonary compliance and poor gas exchange. Respiratory support of such patients in a sea-level environment may require a combination of high-pressure mechanical ventilation and high inspired oxygen tensions. During air evacuation, these patients are routinely exposed to cabin pressures equivalent to 8,000 ft standard atmosphere (564 torr); and during rapid cabin decompression, to pressures equivalent to 40,000 ft standard atmosphere (141 torr). Concern that such environmental situations will exhaust already strained machine and physiological reserves, with potential damage to transported patients, has prompted this evaluation of the effects of altitude on the mechanical performance of ventilators and the functioning of already damaged physiological gas-exchange systems. GRA

N87-15961# Dikewood Corp., Albuquerque, N. Mex.
PROCESSING, EVALUATION AND ANALYSIS OF THE MAG-

NETIC FIELD DATA ACQUIRED BY THE F-106 NOSE BOOM SENSOR Final Report, Jun. 1983 - Apr. 1985
D. V. Giri and S. H. Sands Jun. 1986 57 p Prepared in cooperation with LuTech, Inc., Lafayette, Calif.
(Contract F29601-82-C-0027)
(AD-A172180; DC-FR-1026.3E0-1A; AFWL-TR-85-93) Avail: NTIS HC A04/MF A01 CSCL 14/2

The theoretical development useful in designing an airborne platform for transient or broadband CW electromagnetic field measurement was reported. These theoretical considerations were applied in specifically designing a nose boom B-dot sensor for the NASA F-106B aircraft. Based on this design and some refinements, the Air Force Weapons Laboratory procured such a sensor. During the EMP testing of the NASA F-106B aircraft (February to March 1984 at Kirtland AFB, N. Mex.), extensive data were gathered by the nose boom sensor in various aircraft/simulator configurations. This report documents all of the nose boom data given to LuTech, Inc. The results of processing and analysis accomplished with the given resources are presented in this report. Some additional processing methods appear possible in the future efforts of this nature. GRA

N87-15962# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN OF AIRCRAFT (SELECTED CHAPTERS)
A. A. Badyagin, S. M. Yeger, V. F. Mishin, F. I. Sklyanskiy, and N. A. Fomin 22 Sep. 1986 706 p Transl. into ENGLISH from mono. "Proyektirovaniye Samoletov" Moscow, USSR, 1972 p 1-164, 189-226, 420-515
(AD-A172865; FTD-ID(RS)T-0684-86) Avail: NTIS HC A99/MF A02 CSCL 01/3

General bases and methods of designing aircraft are presented, along with selections of diagrams, power plants and fundamental parameter of aircraft design. This second edition includes the new materials: the methods of optimum design with the use of computers, the method of the gradients of takeoff weight for the evaluation of the designing solutions and conversion of weight characteristics, special feature of the design of aircraft with the shortened and vertical takeoff, the passenger and aerospace aircraft. Sections, which relate taking into consideration of requirements of economy and to design of main aggregates, are considerably expanded and reworked. Appendices to the book are supplemented by characteristics of aircraft engines, by standard combined weight and enumeration of standard electronic equipment. GRA

N87-15963# Aeronautical Research Labs., Melbourne (Australia).
HELICOPTER HOVER PERFORMANCE ESTIMATION COMPARISON WITH UH-IH IROQUOIS FLIGHT DATA
M. J. Williams and A. M. Arney Apr. 1986 38 p
(AD-A173707; ARL-AERO-TM-377) Avail: NTIS HC A03/MF A01 CSCL 01/2

The hover performance of the UH-IH Iroquois has been estimated under a variety of operational conditions using POLAR2, a program based on blade element theory. This program is an improved version of POLAR, a program previously developed at ARL, which did not allow for compressibility effects. The occurrence of these effects in a hovering situation is discussed, and a relationship allowing for such effects has been derived and included in POLAR2. Other improvements, designed to make the program more convenient ot use include the calculation of tail rotor performance together with variables such as tip loss, air density and Lock number which were previously input. The role of the induced velocity factor is also discussed. Finally, comparisons of estimates using POLAR2 and ARDU flight trials data for the UH-IH are presented. GRA

N87-15964# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
QUALIFICATION TESTING OF REDESIGNED F-15/F-4 600 GALLON BI-PAC FUEL TANK CONTAINER
Eileen T. Foley Aug. 1986 31 p
(AD-A173968) Avail: NTIS HC A03/MF A01 CSCL 21/4

In 1985 the F-15/F-4 600 Gallon Bi Pac Container was redesigned. Modifications were incorporated into contract F09063-83-C-1178. Qualification tests were conducted on two production containers in accordance with Federal Test Method Standard No. 101 and Military Standard 648. This test report summarizes the results of the tests and recommends modifications which should be included in current and future production contracts. The redesign F-15/F-4 600 Gallon Bi Pac Fuel Tank Container did not pass all of the required tests. Design changes are recommended to ensure the integrity of the containers and the fuel tanks during shipment and storage. GRA

N87-15965*# United Technologies Research Center, East Hartford, Conn.
AN EXPERIMENTAL INVESTIGATION OF THE STRUCTURAL DYNAMICS OF A TORSIONALLY SOFT ROTOR IN VACUUM Contractor Report, Jun. 1984 - Jun. 1986
A. V. Srinivasan, D. G. Cutts, and H. T. Shu Jul. 1986 96 p
(Contract NAS2-11942)
(NASA-CR-177418; NAS 1.26:177418; AD-A172131; UTRC/R86-956877-19) Avail: NTIS HC A05/MF A01 CSCL 20D

An extensive data base of structural dynamic characteristics has been generated from an experimental program conducted on a torsionally soft two-bladed model helicopter rotor system. Measurements of vibratory strains for five modes of vibration were made at twenty-one locations on the two blades at speeds varying from 0 to 1000 RPM and for several combinations of precone, droop and flexure stiffness. Tests were conducted in vacuum under carefully controlled conditions using a unique excitation device with a system of piezoelectric crystals bonded to the blade surface near the root. Frequencies, strain mode shapes and dampings are extracted from the time histories and can be used to validate structural dynamics codes. The dynamics of the system are such that there is a clear tendency for the first torsion and second flap modes to couple within the speed range considered. Strain mode shapes vary significantly with speed and configuration. This feature is important in the calcualtion of aeroelastic instabilities. The tension axis tests confirmed that the modulus-weighted centroid for the nonhomogeneous airfoil is slightly off the mass centroid and validated previous static tests done to determine location of the tension axis. GRA

N87-15937# Joint Publications Research Service, Arlington, Va.
LOW-GRAVITY USE AIRCRAFT
Heihachiroh Hemura *In its* Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 6-8 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 5-7 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

N87-15966# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
ROTORCRAFT ICING: PROGRESS AND POTENTIAL
Sep. 1986 140 p
(AGARD-AR-223; ISBN-92-835-1535-8) Avail: NTIS HC A07/MF A01

Helicopter icing remains a significant operational consideration for military helicopters operating throughout Europe and northern parts of North America. The working group (WG09) considered the following objectives: (1) to examine rotorcraft icing analysis and modeling; (2) to consider new methods of ice protection; (3) to compare operational experience with ice protected rotorcraft with the design and qualification criteria presently established. The findings of an international group are presented including a comparison of icing atmosphere models and forecasting techniques and an assessment of predictive methods and simulation, flight clearance strategies and requirements. Various new methods of icing protection for rotorcraft are considered. Author

N87-16001# Ferranti Defence Systems Ltd., Edinburgh (Scotland). Electro-Optics Dept.
THE UNMANNED AIRCRAFT AS A FORCE MULTIPLIER
W. H. McKendrick and Maurice R. Pack-Davison *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 15 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

N87-16002# Naval Air Systems Command, Washington, D. C.
NAVY TECHNOLOGY REQUIREMENTS FOR UNMANNED AIRBORNE VEHICLES
P. E. Mullowney *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 5 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

N87-16011# Naval Air Development Center, Warminster, Pa. Aero Analysis Div.
HIGH ALTITUDE, LONG ENDURANCE RPV DESIGN TECHNOLOGY STUDY
Campbell Henderson, Edward McQuillen, and Larry Lehman *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 14 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

N87-16187# Joint Publications Research Service, Arlington, Va.
OPTIMUM BEARING SURFACES OF WINGS WITH INTRICATE GEOMETRY FOR SUPERSONIC FLIGHT Abstract Only
Ye. M. Prokhorov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 1 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 154-160 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

N87-16189# Joint Publications Research Service, Arlington, Va.
NONLINEAR INTEGRO-DIFFERENTIAL EQUATIONS FOR AEROELASTICITY
I. S. Astapov, A. S. Belotserkovskiy, and V. I. Morozov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 44-45 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverkogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 61-70 Original language document was announced in IAA as A86-24287 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N87-15967 ESDU International Ltd., London (England).
INTRODUCTION TO AIR DATA SYSTEM PARAMETERS, ERRORS AND CALIBRATION LAWS
Nov. 1986 20 p Supersedes ESDU-RG1/0
(ESDU-86031; ISBN-0-85679-583-6; ISSN-0141-4054) Avail: ESDU

ESDU 86031 provides an introduction to a series of Items which deal with particular aspects of corrections to air data system measurements. The constituent parts of typical air data systems are described, and the notation convention used througout the series of Items introduced. All relevant air data system parameters are defined and a tabular index to calculation procedures is included. A separate section gives the calibration laws for altimeter, airspeed indicator and Machmeter. ESDU

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N87-15968# Rolls-Royce Ltd., Derby (England).
PROPULSION
J. R. Sadler 29 Jul. 1986 44 p
(PNR90321; ETN-87-98771) Avail: NTIS HC A03/MF A01

The principles and history of aircraft propulsion are recalled. The influence of fuel and maintenance economics and legal obligations is discussed. ESA

N87-15969# Rolls-Royce Ltd., Derby (England).
DESIGNING WITH TITANIUM
J. F. Coplin 7 Jan. 1986 49 p Presented at an Institute of Metals Conference, 7 Jul. 1986
(PNR90325; ETN-87-98774) Avail: NTIS HC A03/MF A01

The use of titanium in aircraft engines, particularly compressors, is reviewed. Material properties, manufacturing, and developments are discussed. ESA

N87-15970# Rolls-Royce Ltd., Derby (England).
A STUDY OF PASSAGE FLOW THROUGH A CASCADE OF TURBINE BLADES USING IMAGE PLANE HOLOGRAPHIC INTERFEROMETRY
M. L. G. Oldfield (Oxford Univ., England), P. J. Bryanston-Cross, J. H. Nicholson, and C. T. J. Scrivener 19 May 1986 12 p Sponsored by the UK Ministry of Defence Procurement Executive
(PNR90326; ETN-87-98775) Avail: NTIS HC A02/MF A01

Holographic interferograms showing the flow through two passages of a cascade of turbine rotor blades in an isentropic light piston tunnel with full-scale Reynolds numbers, Mach numbers, and gas-to-wall temperature ratios are presented. Double exposure absolute and differential image plane holograms of the complete flow field under a range of conditions were obtained. The isodensity contours predicted by a time marching throughflow calculation compare well with the positions of the interference fringe on the holograms. The intersections of these fringes with the blade surfaces give blade surface Mach numbers which agree well with those from surface pressure measurements. Wakes, shock waves, and the presence of upstream and side wall turbulence are all evident in the holograms. ESA

N87-15971 Department of the Air Force, Washington, D.C.
TEMPERATURE DETECTION SYSTEM FOR USE ON FILM COOLED TURBINE AIRFOILS Patent
Robert Frederick, inventor (to Air Force) Issued 17 Jun. 1986 4 p Supersedes US-Patent-Appl-SN-729388
(AD-D012475; US-Patent-4,595,298; US-Patent-Appl-SN-729388; US-Patent-Class-374-144) Avail: US Patent and Trademark Office CSCL 14/2

This patent discloses an improved temperature detection system for use on film cooled turbine airfoils having a showerhead assembly with a series of parallel slots defined in the leading edge of an airfoil, each slot having a multiplicity of film flow ports exiting therefrom. A plurality of sensor assemblies are affixed to the airfoil showerhead and are couplable via electrodes to electronic sensing equipment for establishing the gas flow temperature. GRA

N87-15972 Department of the Air Force, Washington, D.C.
VARIABLE CYCLE ENGINE FOR HIGH ALTITUDE AIRCRAFT Patent
G. D. Brewer, inventor (to Air Force) Issued 8 Jul. 1986 6 p Supersedes US-Patent-Appl-SN-698720
(AD-D012522; US-Patent-4,598,543; US-Patent-Appl-SN-698720;

US-Patent-Class-60-39.161) Avail: US Patent and Trademark Office CSCL 21/5

A turboshaft engine is modified to be able to operate as a turbojet or a turboprop by the movement of an annular slide valve that directs gas flow between a high pressure turbine and a low pressure turbine. GRA

N87-15973# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.

AN ANALYTICAL STUDY OF ICING SIMILITUDE FOR AIRCRAFT ENGINE TESTING Final Report, Sep. 1985 - Jun. 1986

C. S. Bartlett Oct. 1986 110 p Prepared in cooperation with AEDC

(AD-A173713; AEDC-TR-86-26; DOT/FAA/CT-86/35) Avail: NTIS HC A06/MF A01 CSCL 04/2

An analytical study was conducted of the requirements for achieving similitude for icing as test conditions were varied. The application is aimed at engine icing tests conducted in ground spray rig facilities. The analysis considers the changes in the icing test conditions, including static temperature, static pressure, liquid water content, droplet size, and flow velocity, that are required to achieve similitude if any of the conditions are changed. The analysis uses a math model of icing scaling which has been validated by experimental data collected at the AEDC icing research tunnel. The requirements for similitude were analyzed for changes in both temperature and pressure. Expressions to describe the influence of test condition changes on the value of the scaling parameter were developed. The effect of icing caused by free-stream static temperature changes and temperature rise through a generic high-bypass turbofan engine was studied. The icing test points listed for compliance testing for aircraft icing certification under guidelines given in the FAA Advisory Circular (AC) 20-73 were used as test points for the analyses. GRA

N87-15974# General Electric Co., Binghamton, N.Y. Armament and Electrical Systems Dept.

PERMANENT MAGNET VARIABLE SPEED CONSTANT FREQUENCY POWER GENERATION SYSTEM Final Report, Aug. 1978 - Jun. 1984

G. P. Koerner and E. U. Siddiqui Mar. 1986 161 p

(Contract F336125-78-C-2200)

(AD-A173959; AES-14070; AFWAL-TR-85-2112) Avail: NTIS HC A08/MF A01 CSCL 10/2

The design, development, and aircraft installation of a 60-KVA permanent magnet starter-generator system is presented. The primary objective of this program was to advance the permanent magnet technology and demonstrate that a flexible, reliable, and low-cost starting means can be provided. The electrical system, developed under this program, obviates the use of large air ducts and complicated gearboxes, clutches, and torque converters. Eleven systems were fabricated and flight qualification was completed. The starting capability was demonstrated at Syracuse Air National Guard base and at the General Electric Engine facility in Lynn, Massachusetts. An A-10 aircraft was completely modified at Nellis Air Force base, and the permanent magnet starter-generator was installed. The planned flight test was deferred by Tactical Air Command and, thus, the aircraft was demodified and placed into regular operation. GRA

N87-16172# Joint Publications Research Service, Arlington, Va.

DISCOVERY DOUBLES JET ENGINE THRUST IN EXPERIMENTS

In its USSR Report: Engineering and Equipment 13 Aug. 1986 p 58 Transl. into ENGLISH from Vechernyaya Moskva (Moscow, USSR), 20 Mar. 1986 p 1 (For primary document see N87-16171 08-31)

Avail: NTIS HC A04/MF A01

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N87-15975*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PREDICTION OF WING AEROELASTIC EFFECTS ON AIRCRAFT LIFT AND PITCHING MOMENT CHARACTERISTICS

Clinton V. Eckstrom Oct. 1986 19 p Presented at the AGARD Specialists Meeting on Static Aeroelastic Effects on High Performance Aircraft, Athens, Greece, 1-2 Oct. 1986

(NASA-TM-89060; NAS 1.15:89060) Avail: NTIS HC A02/MF A01 CSCL 01C

The distribution of flight loads on an aircraft structure determine the lift and pitching moment characteristics of the aircraft. When the load distribution changes due to the aeroelastic response of the structure, the lift and pitching moment characteristics also change. An estimate of the effect of aeroelasticity on stability and control characteristics is often required for the development of aircraft simulation models of evaluation of flight characteristics. This presentation outlines a procedure for incorporating calculated linear aeroelastic effects into measured nonlinear lift and pitching moment data from wind tunnel tests. Results are presented which were obtained from applying this procedure to data for an aircraft with a very flexible transport type research wing. The procedure described is generally applicable to all types of aircraft. Author

N87-15976*# Calspan Advanced Technology Center, Buffalo, N.Y.

FLARED LANDING APPROACH FLYING QUALITIES. VOLUME 2: APPENDICES Final Report, Apr. 1985 - Sep. 1986

Norman C. Weingarten, Charles J. Berthe, Jr., Edmund G. Rynaski, and Shahan K. Sarrafian Dec. 1986 456 p

(NASA Order L-85272-B; Contract F33615-83-C-3603)

(NASA-CR-178188-Vol-2; Rept-7205-13-Vol-2; NAS 1.26:178188-Vol-2) Avail: NTIS HC A20/MF A01 CSCL 01C

An in-flight research study was conducted utilizing the USAF/ Total In-Flight Simulator (TIFS) to investigate longitudinal flying qualities for the flared landing approach phase of flight. A consistent set of data were generated for: determining what kind of command response the pilot prefers/requires in order to flare and land an aircraft with precision, and refining a time history criterion that took into account all the necessary variables and the characteristics that would accurately predict flying qualities. Seven evaluation pilots participated representing NASA Langley, NASA Dryden, Calspan, Boeing, Lockheed, and DFVLR (Braunschweig, Germany). The results of the first part of the study provide guidelines to the flight control system designer, using MIL-F-8785-(C) as a guide, that yield the dynamic behavior pilots prefer in flared landings. The results of the second part provide the flying qualities engineer with a derived flying qualities predictive tool which appears to be highly accurate. This time-domain predictive flying qualities criterion was applied to the flight data as well as six previous flying qualities studies, and the results indicate that the criterion predicted the flying qualities level 81% of the time and the Cooper-Harper pilot rating, within + or - 1%, 60% of the time. Author

N87-15977*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ESTIMATION OF BIAS ERRORS IN MEASURED AIRPLANE RESPONSES USING MAXIMUM LIKELIHOOD METHOD

Vladiaslav Klein and Dan R. Morgan Jan. 1987 34 p

(NASA-TM-89059; NAS 1.15:89059) Avail: NTIS HC A03/MF A01 CSCL 01C

A maximum likelihood method is used for estimation of unknown bias errors in measured airplane responses. The mathematical model of an airplane is represented by six-degrees-of-freedom kinematic equations. In these equations the input variables are replaced by their measured values which are assumed to be without

random errors. The resulting algorithm is verified with a simulation and flight test data. The maximum likelihood estimates from in-flight measured data are compared with those obtained by using a nonlinear-fixed-interval-smoother and an extended Kalmar filter.
Author

N87-15978# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MODELLING OF RIGID-BODY AND ELASTIC AIRCRAFT DYNAMICS FOR FLIGHT CONTROL DEVELOPMENT M.S. Thesis
John J. Cerra, II Jun. 1986 118 p
(AD-A172423; AFIT/GAE/AA-86J-2) Avail: NTIS HC A06/MF A01 CSCL 01/3

The purpose of this effort was to provide a method of developing a linear model of an elastic aircraft. The model provides the capability to analyze the coupling between the rigid and elastic motion of the aircraft. The method developed in this effort obtains stability derivatives directly from unsteady aerodynamic forces. This results in a state space model whose states are just the normal aircraft states and rates, the structural coordinates and rates, and the control surface positions and rates. Using a representation of the YF-17 wind tunnel flutter model, it was demonstrated that the methodology developed predicted the required dynamics to make this a viable method of modelling rigid body and flutter behavior of the model. Flutter control laws were designed for motion about an equilibrium condition represented by a velocity 20% above the flutter velocity. Both classical and modern techniques yielded acceptable control laws. The control laws were also analyzed at off design conditions to check robustness. GRA

N87-15979# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA AERONAUTICA ET ASTRONAUTICA SINICA (SELECTED ARTICLES)
Zhongji Chen, Hongyue Zhang, Zhiming Xin, Shicum Wang, and Longde He 10 Oct. 1986 51 p Transl. into ENGLISH from Hang Kong Xuebao (China), v. 6, no. 6, Dec. 1985 p 513-520; 521-529; 585-589
(AD-A173610; FTD-ID(RS)T-0834-86) Avail: NTIS HC A04/MF A01 CSCL 01/3

Topics addressed include: adaptive control techniques; robustness (mathematics); helicopter stability and controllability; hingeless rotors; three-dimensional unsteady flow; delta wings; angle of attack; computational fluid dynamics; and rotor-induced blade flapping. B.G.

N87-15936# Joint Publications Research Service, Arlington, Va.
OPTICAL TRANSDUCER: STOL AIRCRAFT
In its Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 3-5 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jul. 1986 p 2-3 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N87-15980*# National Aeronautics and Space Administration, Washington, D.C.
SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION IN THE FLOW FIELD OF A TRI-DIMENSION WIND TUNNEL
R. Benay and T. Pot Sep. 1986 38 p Transl. into ENGLISH from Interaction Onde de Choc/Couche Limite Turbvulente en Coulement de Canal Tridimensionnel (France) ONERA TP, No. 1985-151, 1985 Presented at the 22nd Symposium on Applied Aerodynamics, Lille, France, 13-15 November, 1985 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was prepared by National Center for Aerospace Test and Research, Chatillon, France
(Contract NASw-4004)
(NASA-TM-88482; NAS 1.15:88482) Avail: NTIS HC A03/MF A01 CSCL 14B

The first results of a thorough experimental analysis of a strong three-dimensional shock-wave/turbulent boundary-layer interaction occurring in a three dimensional transonic channel are presented. The aim of this experiment is to help in the physical understanding of a complex field, including several separations, and to provide a well documented case to test computational methods. The flowfield has been probed in many points by means of a three-component laser Doppler velocimeter. The results presented relate only to the mean velocity field. They clearly show the formation in the flow of a strong vortical motion resulting from the shock wave interaction. Author

N87-15981# Pallen-Johnson Associates, Inc., Vienna, Va.
AIRPORT PAVEMENT LOAD ANALYSIS Final Report
Stephen Hall 2 Sep. 1986 131 p
(Contract DTFA01-84-Y-01052)
(DOT/FAA/PM-86/36) Avail: NTIS HC A07/MF A01

The underlying theory and assumptions used in developing microcomputer software to determine and model the cumulative load distribution across any given airport pavement as a function of aircraft type and usage of the pavement are described. Author

N87-15982# Office of Naval Research, London (England).
AERODYNAMICS RESEARCH AND DEVELOPMENT AT THE ROYAL AIRCRAFT ESTABLISHMENT (RAE), FARNBOROUGH IN THE UNITED KINGDOM
L. L. Coburn 9 Jul. 1986 9 p
(AD-A171837; ONRL-R-5-86) Avail: NTIS HC A02/MF A01 CSCL 20/4

This report is a survey of the organization and division of functions of the RAE research and development. It includes a summary that compares the UK MoD research establishments with the US Navy laboratories. GRA

N87-15983# Admiralty Marine Technology Establishment, Teddington (England).
THE ARE (ADMIRALTY RESEARCH ESTABLISHMENT) (GLEN FRUIN) DENSITY STRATIFIED TANK
R. J. Bartlett and P. M. Rodger May 1986 61 p
(AD-A174188; AMTE(N)-R85008; DRIC-BR-100640) Avail: NTIS HC A04/MF A01 CSCL 20/4

The conversion of an experimental tank at Glen Fruin into one of the world's largest stratified test facilities is described. The stages of development and the commissioning tests are reported. The tank is shown to offer a stable environment for research on buoyancy influenced flows with relatively weak density gradients and a relatively large cross section. Author (GRA)

N87-15984# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
DESIGN, EVALUATION AND USE OF A REVERBERATION CHAMBER FOR PERFORMING ELECTROMAGNETIC SUSCEPTIBILITY/VULNERABILITY MEASUREMENTS
M. L. Crawford and G. H. Koepke Apr. 1986 149 p Sponsored by Naval Surface Weapons Center and RADC
(PB86-227410; NBS-TN-1092) Avail: NTIS HC A07/MF A01; also available SOD HC $7.00 as 003-003-02734-1 CSCL 14B

The report presents the results of work at the National Bureau of Standards, Boulder, Colorado, to carefully evaluate, document, develop (when necessary), and describe the methodology for performing radiated susceptibility/vulnerability measurements using a reverberation chamber. The report describes the reverberation chamber theory of operation, evaluation, functional operation, and use for performing immunity measurements. It includes an estimate of measurement uncertainties derived empirically from test results

and from comparisons with anechoic chamber measurements. Finally, it discusses the limitations and advantages of the measurement technique to assist potential users in determining the applicability for the technique to their electromagnetic compatibility (EMC) measurement needs. GRA

N87-15985# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON FLIGHT SIMULATION
Anthony M. Cook (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) Oct. 1986 14 p Symposium held in Cambridge, England, 30 Sep. - 3 Oct. 1985 (AGARD-AR-234; ISBN-92-835-0399-6) Avail: NTIS HC A02/MF A01

In recent years, important advances were made in technology both for ground-based and in-flight simulators. There was equally a broadening of the use of flight simulators for research, development, and training purposes. An up-to-date description of the state-of-the-art of technology and engineering was provided for both ground-based and in-flight simulators and their respective roles were placed in context within the aerospace scene. Author

N87-16763*# University of Southern Mississippi, Hattiesburg. Dept. of Engineering Technology.
DEVELOPMENT OF AUTOMATED ELECTROMAGNETIC COMPATIBILITY TEST FACILITIES AT MARSHALL SPACE FLIGHT CENTER
Cecil A. Harrison *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 17 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

N87-16774*# Washington and Lee Univ., Lexington, Va. Dept. of Physics.
MODIFICATIONS OF THE X-RAY SOURCE AND MONITOR AT THE X-RAY CALIBRATION FACILITY
W. Barlow Newbolt *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 18 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N87-15986# Naval Postgraduate School, Monterey, Calif.
ALFRED THAYOR MAHAN AND SPACE: A NECESSARY UNITY M.S. Thesis
Mark T. Sandvigen Jun. 1986 112 p
(AD-A174007) Avail: NTIS HC A06/MF A01 CSCL 22/1

This thesis is an unclassified examination from a Western perspective, of the current and projected space efforts of the world and how they effect current U.S. Space Policy. There is currently no universally accepted space strategy to help in meeting the policy goals of the United States. It is the hypothesis of this thesis that the strategies needed to deal effectively with future space development were layed down in the past by Alfred Thayor Mahan and others. In order to outline a current strategy an analysis was conducted of current space programs, future space efforts, orbitology/orbital mechanics, and the writings of H. Jomini, A. T. Mahan, and Sir Julian Corbett. In order to manage and arrange the large knowledge base, a systems model was developed and used in this analysis. Upon the completion of the analyses, a blending of the Mahan and orbital mechanics was conducted in order to show, by analogy, that there exist parallels between that of naval strategy and strategies needed to reach US policy goals. GRA

N87-15987# Joint Publications Research Service, Arlington, Va.
JAPAN REPORT: SCIENCE AND TECHNOLOGY
2 Jul. 1986 76 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-86-018) Avail: NTIS HC A05/MF A01

Topics addressed include: aerospace sciences; biotechnology; defense industry; energy; laser technology; and nuclear development. For individual titles, see N87-15988 through N87-15990.

N87-15988# Joint Publications Research Service, Arlington, Va.
DETAILS OF CURRENT SPACE DEVELOPMENT PLAN DESCRIBED
In its Japan report: Science and Technology (JPRS-JST-86-018) 2 Jul. 1986 p 1-24 Transl. into ENGLISH from Koku Tenbo (Tokyo, Japan), 1985 p 489-508 (For primary document see N87-15987 08-12)
Avail: NTIS HC A05/MF A01

The current Space Development Plan (enacted 13 March 1985) was formed in response to needs by reviewing the previous Space Development Plan in consideration of the progress of domestic research and development, changes in the international environment, and the long-range outlook concerning the uses of space development. The Space Development Plan (13 March 1985) is outlined. B.G.

N87-15989# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT, STATUS, PROSPECTS OF MARINE OBSERVATION SATELLITE **c18**
Kohei Arai *In its* Japan report: Science and Technology (JPRS-JST-86-018) 2 Jul. 1986 p 25-40 Transl. into ENGLISH from Kaiyo Kagaku (Tokyo, Japan), Aug. 1985 p 510-516 (For primary document see N87-15987 08-12)
Avail: NTIS HC A05/MF A01

The purpose for the development of the Marine Observation Satellite No 1 (MOS-1), the first Japanese Earth observation satellite, its present condition, future plans, systems, observational principles, and possibilities for observation are discussed. Author

N87-15990# Joint Publications Research Service, Arlington, Va.
OVERVIEW OF PLANNED TESTS OF SPACE MATERIALS
In its Japan report: Science and Technology (JPRS-JST-86-018) 2 Jul. 1986 p 41-43 Transl. into ENGLISH from Toshi Keizai (Tokyo, Japan), Jan. 1986 p 52-53 (For primary document see N87-15987 08-12)
Avail: NTIS HC A05/MF A01

The National Space Development Agency (Japan) started space materials tests by using the two-stage rocket TT III 500 A. As the next step, full scale space tests that make use of the Spacelab are scheduled to take place in early 1988. The next rounds of tests that follow will take place on the space station. These projects are briefly outlined. B.G.

N87-16029*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1 RESEARCH OVERVIEW
G. C. Horner *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 233-251 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

N87-16030*# Harris Corp., Palm Bay, Fla.
DESCRIPTION OF THE MAST FLIGHT SYSTEM
Ronald C. Talcott and John W. Shipley *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 253-263 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

N87-16034*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1 GUEST INVESTIGATOR PROGRAM
Anthony Fontana and Robert L. Wright *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986

p 319-325 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N87-15991 Texas Univ., Austin.
THEORY OF COORBITAL MOTION Ph.D. Thesis
Alexander Stephen Konopliv 1986 135 p
Avail: Univ. Microfilms Order No. DA8618514

The gravitational interaction of two small coorbital satellites in nearly identical orbits about a large central mass is investigated. This involves the study of the general three-body problem as well as the restricted three-body problem. Since the eccentricity is small, dynamical models are developed by expanding the equations of motion in rotating polar coordinates about a circular orbit. For numerical investigation, a combination of Hill's variables and equinoctial variables is used to find series solutions expanded in time. From these series solutions, highly accurate averaged equations are determined. To study the stability of the motion, periodic orbits are generated and the linearized stability is found from the eigenvalues of the state transition matrix. Dissert. Abstr.

N87-15992 Texas Univ., Austin.
A NUMERICAL INVESTIGATION OF THE ANISOTROPIC KEPLER PROBLEM Ph.D. Thesis
Kyeum Rae Cho 1986 131 p
Avail: Univ. Microfilms Order No. DA8618436

The anisotropic Kepler problem is a variation on the well-known standard Kepler problem. The standard Kepler problem is completely integrable and regularizable. Angular momentum is conserved, and the orbits are well-known. However, when the symmetry is destroyed (as in the anisotropic Kepler problem) the problem becomes non-integrable and non-regularizable. The angular momentum is not conserved, and orbit structure is very complicated. Different formulations of the problems and equations of motion are described first. Next, the properties of the collision manifold are discussed following the approach of McGehee. This allows us to understand the flow near the origin. The offset anisotropic Kepler problem, in which a particle is restricted to remain in a horizontal plane z sub min = a, is also discussed. Periodic orbits with negative energy are obtained and the stability index is computed with three different methods: Variational equations, Henon, and Hill. Finally, periodic solutions and their stability properties are discussed. Previous studies have classified this problem as extremely unstable. However, two stable periodic orbits are described. Surface of section plots reveal that these orbits are in fact elliptic fixed points. Computation of the Gaussian curvature and Kolmogorov entropy confirm the nature of these orbits. Dissert. Abstr.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N87-15993# Army Engineer Waterways Experiment Station, Livermore, Calif. Structures Lab.
BLAST ANALYSIS AND DESIGN OF ROCKET ENGINE TEST FACILITY CONTROL ROOMS Final Report
Richard C. Dove and Sam A. Kiger Jul. 1986 43 p
(AD-A171679; WES-TR-SL-86-13) Avail: NTIS HC A03/MF A01 CSCL 19/4

In support of plans to add a second control room to the Rocket Engine Test Facility at NASA, Cleveland, Ohio, the existing control room was analyzed to determine the most severe accidental explosion it could safely withstand. This potential accident was used as the design threat to develop a preliminary design for the new control room. The analysis and design calculations were based on procedures from Army TM 5-1300/NAVFAC P-397/AFM 88-22 and the computer program CBARCS, which automates some of the procedures in the manual. To evaluate the degree of conservatism in the analysis, experimental data with charge weights and structural dimensions similar to the control room's were selected and analyzed. Results indicate that the existing room will safely withstand an explosion equivalent to 1,000 lb of TNT detonated at the rocket test stand 20 ft away. To survive the same accident, the new control room (to be constructed on top of the old one) should have 1-ft thick walls. Existing walls are 2 ft thick with 0.33% reinforcement (existing walls have 1.55%). Comparison of data with analysis indicates that an accidental explosion equivalent to approx. 1,800 lb of TNT will cause unacceptable damage to the control room. This analysis results in a much more economical design for the new control room than would be achieved by constructing a new room identical to the old control room. GRA

N87-15994 Department of the Air Force, Washington, D.C.
ROTOR BLADE TEST APPARATUS Patent
Edwin C. Taschner, inventor (to Air Force) and Edward M. Myzska, inventor (to Air Force) Issued 12 Aug. 1986 5 p Supersedes US-Patent-Appl-SN-737377
(AD-D012523; US-Patent-4,604,896; US-Patent-Appl-SN-737377; US-Patent-Class-73-583) Avail: US Patent and Trademark Office CSCL 14/2

This patent discloses a rotor blade test apparatus having a striking solenoid to strike a rotor blade to generate an audio signal. A microphone receives the audio signal and applies it to a spectrum analyzer wherein the predominant natural frequencies of the rotor blade are determined. GRA

N87-15995# Naval Research Lab., Washington, D. C.
THE SPACE STATION MICROWAVE FACILITY
K. W. Weiler, B. K. Dennison, R. M. Bevilacqua, J. H. Spencer, and K. J. Johnston 19 Sep. 1986 78 p
(AD-A173964; NRL-MR-5821) Avail: NTIS HC A05/MF A01 CSCL 22/2

A large millimeter wavelength interferometer array is proposed for construction on the planned space station (The Space Station Microwave Facility-SSMF). It will have manifold applications in both basic and applied research and will be the premier instrument in the world at high radio frequencies. All weather target detection and identification, Earth resource mapping, middle atmospheric studies, ionospheric research, atmospheric infrared background investigations, interplanetary communications, and high frequency radio astronomy are only a few of the areas which will be significantly advanced by the availability of such an instrument. Particularly in astronomy, the ability to do observations above the disturbing and absorbing effects of the Earth's atmosphere will allow new opportunities for exploration of all objects from the Sun, through the Solar System bodies, to the interstellar medium of the Milky Way and other galaxies, out to the most distant quasars with resolution and sensitivity equalling or exceeding all existing or planned millimeter wavelength telescopes. GRA

N87-16041*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT AND USE OF A LINEAR MOMENTUM EXCHANGE DEVICE
George B. Doane, III (Control Dynamics Co., Huntsville, Ala.), Henry Waites, and G. David Edgemon *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 431-440 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N87-15996*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTAUR D1-A SYSTEMS IN A NUTSHELL
Andrew L. Gordan Jan. 1987 29 p
(NASA-TM-88880; E-3287; NAS 1.15:88880) Avail: NTIS HC A03/MF A01 CSCL 22D

This report identifies the unique aspects of the Centaur D1-A systems and subsystems. Centaur performance is described in terms of optimality (propellant usage), flexibility, and airborne computer requirements. Major systems are described narratively with some numerical data given where it may be useful. Author

N87-15997# Ballistic Research Labs., Aberdeen Proving Ground, Md.
EFFECTS OF SMALL NOSE BLUNTNESS ON STATIC STABILITY AND MAGNUS CHARACTERISTICS OF A PROJECTILE SHAPE AT MACH 0.91 AND 3.03
Lyle D. Kayser Jul. 1986 44 p
(AD-A171734; BRL-MR-3535) Avail: NTIS HC A03/MF A01 CSCL 19/1

Wind tunnel test results on a typical projectile shape with small nose bluntness are reported. Flat and hemispherical nose tip results are shown in addition to sharp nose tip results. The effects of nose bluntness on static stability are shown to be negligible at both Mach 0.91 and 3.02. The effects of nose bluntness on Magnus force and Magnus moment were not large, but of sufficient magnitude to indicate that such bluntness should not be neglected in a numerical flow field computation.
Author (GRA)

N87-15998 Department of the Air Force, Washington, D.C.
ZERO ADHESION SYSTEM Patent
Joseph N. Steinmetz, Jr., inventor (to Air Force) Issued 29 Jul. 1986 4 p Supersedes US-Patent-Appl-SN-623873
(AD-D012493; US-Patent-4,602,552; US-Patent-Appl-SN-623873; US-Patent-Class-89-1.816) Avail: US Patent and Trademark Office CSCL 16/4

This patent discloses a zero adhesion system whereby a protective missile launch pad is held against an Environmental Protection Material (EPM) coated missile skin surface having an intermediary cloth sheet inbetween. The pad comprises a steel sheet having perforated cleats defined therein, which sheet is affixed to the underside of the pad and releasably bears against the intermediary cloth sheet. This arrangement operates such that the protective missile launch pad is freely released from the missile at launch without adhesion to the EPM coated missile skin.
Author (GRA)

N87-15999# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THERMAL EFFECTS ON A ROTATING MISSILE M.S. Thesis
David H. Kristensen Mar. 1986 96 p
(AD-A172799; AFIT/GNE/ENP/86M-9) Avail: NTIS HC A05/MF A01 CSCL 16/4

An attempt is made to determine if rotation would decrease the maximum skin temperature of an ICBM, thus increasing its probability of survival, The first scenario investigated was the Peacekeeper Dense Pack system. The missile field was subjected to a walk attack of 2 MAT weapons, with incoming RV's exploding every two secs. The 2nd scenario was a 4-on-1 attack of a missile launching system; specifically, one missile was subjected to four bursts located in various positions surrounding the missile. Finally, a missile is attacked by a space-based laser with a maximum absolute power of 10 megawatts. In all cases, the rotation rate was limited to a maximum of 1.6 radians/sec. In all scenarios studied, rotation significantly decreased the maximum skin temperature and increased the missile's probability of survival. The decrease was most dramatic for the walk attack where an optimum rotation rate of .8 radians/sec was established. For the 4-on-1 attack, rotation was effective but required the maximum 1.6 radians/sec rotation rate for best results. For the laser threat, rotation was effective, with the maximum rotation rate providing the greatest amount of protection.
GRA

N87-16000# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
GUIDANCE, CONTROL AND POSITIONING OF FUTURE PRECISION GUIDED STAND-OFF WEAPONS SYSTEMS
Loughton, England Jun. 1986 263 p In ENGLISH and FRENCH Symposium held in Ottawa, Ontario, 8-11 Oct. 1985
(AGARD-CP-388; ISBN-92-835-0390-2) Avail: NTIS HC A12/MF A01

Topics addressed include: tactical operational requirements; weapon systems concepts; design criteria and integration issues; tactical mission planning and management, communication; sensor aspects for guidance and control, position, and navigation; computational techniques and data processing; and system demonstrations. For individual titles, see N87-16001 through N87-16011.

N87-16001# Ferranti Defence Systems Ltd., Edinburgh (Scotland). Electro-Optics Dept.
THE UNMANNED AIRCRAFT AS A FORCE MULTIPLIER c05
W. H. McKendrick and Maurice R. Pack-Davison *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 15 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

A principal role for small military remote piloted vehicles (RPVs) now and in the foreseeable future is to enhance the effectiveness of other weapon systems, in particular those capable of delivering munitions against distant targets. The requirement is for a force multiplier which can be used to increase weapon effectiveness and weaken the offensive and defensive capability of the enemy. How the RPV System design and configuration are influenced by a requirement to act as a force multiplier is discussed. The approach adopted is to concentrate initially on the target acquisition role and show how mission requirements impinge on every level of RPV system design. The discussion is then generalized to other weapon support roles and finally to the implication of a multiple-role capability on RPV system equipment and operation.
Author

N87-16002# Naval Air Systems Command, Washington, D. C.
NAVY TECHNOLOGY REQUIREMENTS FOR UNMANNED AIRBORNE VEHICLES c05
P. E. Mullowney *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 5 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

Navy technology requirements for unmanned airborne vehicles are most unique in their shipboard launch, recovery, and maintainability. The current and future Remotely Piloted Vehicle (RPV) programs will demand cost and mission effective systems with a high degree of survivability. Cost effectiveness will be emphasized from the shipboard operation end of the problem, starting with storage, launch, remote piloting and data acquisition, through the tradeoff of expendability versus recovery, and shipboard maintenance and Instrument Landing System (ILS) concepts. Until the technology can provide RPVs fully integrated with shipboard operations, Navy applications will remain the same.
B.G.

N87-16003# Singer Co., Wayne, N. J. Kearfott Div.
DESIGN/DEVELOPMENT TRADEOFFS TO ACHIEVE A MISSION EFFECTIVE SOW GUIDANCE SYSTEM
Albert J. Shapiro *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems (date)

14 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

The increasing role of Precision Guided Standoff Weapons (PGSOW) places special requirements on the navigation systems conventionally provided to this class of vehicles. The standoff mission requires innovative system concepts altogether different from the conventional system configurations that have become almost a standard approach to fighter and bomber navigation systems. This need for innovation is even more necessary if the SOW navigation system is to be affordable and mission effective in the context of these small relatively low cost vehicles. The navigation requirements are developed and reviewed. A trade-off of the alternatives as a function of guidance effectiveness are identified and performed. From the spectrum of navigation system alternatives, the specifics of a multiple sensor self-contined system is developed showing the benefits to be derived by optimum integration of low cost sensors. The key elements of this integrated multiple sensor navigation system are described. Author

N87-16004# Science Applications International Corp., Huntsville, Ala.
LETHAL AIR DEFENSE SUPPRESSION TECHNOLOGY BASE DEFINITION c66
Harold L. Pastrick, John A. Frech, William R. Day, and Anthony Biele (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 10 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

One of the major thrusts of the Air Force Armament Laboratory is to develop technologies for the advanced weapons required to accomplish lethal defense suppression. In order to develop the long range investment strategy for this thrust, a Technology Base Definition Study for lethal defense suppression was conducted. A major product was a Long-Range Integrated Technology Plan which: identifies specific technology efforts; outlines their required maturity dates to meet the envisioned weapon system needs; and then establishes the investment strategy required to meet the thrust objectives. In addition to, and in support of the development of the long-range plan, a threat survey, a user survey, a system survey, and a technology survey, as well as a cost and operational effectiveness analysis, was conducted and published as separate reports. It was concluded that the required technologies to achieve a cost effective weapon system would best be directed toward a long-range, semi-ballistic missile with a dispenser/submunition warhead. Six major technology areas were described for further research and development exploitation through the year 1998 and a total of eleven elements were defined in the 12 year planning cycle. Author

N87-16005# System Dynamics, Inc., Gainesville, Fla.
MIDCOURSE GUIDANCE FOR THE US ARMY'S LOW COST FIBER OPTIC GUIDED MISSILE
William Boykin and Paul Jacobs (Army Missile Lab., Redstone Arsenal, Ala.) *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 17 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

A method for achieving midcourse guidance using a digital correlator and known white rocks, or positions of objects that appear in the seeker video is analyzed. A variety of filtering techniques and filter mechanizations are analyzed and the results presented. Algorithms are developed which use updates from the ensemble of white rocks or waypoints to correct the missile attitude at each waypoint and predict time or range to go to the target area. Models for the system dynamics and the measurement process were formulated and six extended Kalman filter designs were developed and tested for state estimation accuracy and efficiency. Work was also performed to improve the efficiencies of the algorithms so that the estimates are available in a timely manner for midcourse navigation and to aid the operator. B.G.

N87-16006# National Aerospace Lab., Amsterdam (Netherlands).
TACTICAL MISSION PLANNING AND MANAGEMENT c66
P. J. M. Urlings and A. L. Spijkervet *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 9 p Previously announced as N87-14198 (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

The operational requirements for automation of tactical mission planning and management are summarized. Based on these requirements, the CAMPAL-system is reviewed. Analysis software packages are highlighted, since they provide the CAMPAL-system with planning features for penetration and attack. Developments in tactical mission planning and management suggested by advances in knowledge engineering and expert systems are discussed. ESA

N87-16007# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
COLLISION PROBABILITY OF CRUISE MISSILES FLYING IN FORMATION [PROBABILITE DE COLLISION DE MISSILES DE CROISIERE VOLANT EN FORMATION]
Michel Ferrand and Philippe Riot *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Oct. 1985 8 p In FRENCH (For primary document see N87-16000 08-15)
Avail: NTIS HC A01/MF A01

A collision rule for Cruise missiles flying in formation at the same altitude is established mathematically. The mean rate of loss for a multi-missile mission with a trajectory including several segments is then determined. The presentation concludes with a numerical application. B.G.

N87-16008# Societe Nationale Industrielle Aerospatiale, Paris (France). Div. Engins Tactiques.
STRAPDOWN INERTIAL SYSTEMS APPLICATIONS FOR TACTICAL MISSILES (STAND-OFF MISSILES)
Puech *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 16 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

Strapdown Inertial Systems (SDIS) are particularly well suited for tactical standoff missile applications. This certainty was made clear by several years of theoretical design work and trials. Initial theoretical work made wide use of parameters giving detailed definition of missile trajectories and motions as obtained from measurements made on weapon systems then in development or production. Sensors (principally gyroscopes) were laboratory tested. These preliminary design efforts led to selection of various technologies such as the laser gyro and the mechanical gyro, each being adapted to the weapon system in question. Share-out of functions between various equipment items was defined. Comparison of the advantages and disadvantages of these technologies shows that today the laser gyro is principally retained for high and medium range levels of precision, with the mechanical (spin-stabilized) gyro serving in the medium and low precision range. Since requirements are ever increasing in the fields of dynamic performance and robustness, it is here that most progress is expected. Author

N87-16009# Electronique Serge Dassault, St. Cloud (France).
GUIDED STAND-OFF WEAPONS AND THE EVALUATION OF MEANS FOR LAUNCH CALCULATION: THE APPLICATION OF NEW TECHNIQUES [LES ARMES GUIDEES TIREES A DISTANCE DE SECURITE ET L'EVOLUTION DES MOYENS DE CALCUL EMBARQUE: L'APPORT DES TECHNIQUES NOUVELLES] c66
J. P. Quemard *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Oct. 1985 8 p In FRENCH (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

The future development and utilization of guided standoff weapons is examined with particular emphasis on the development of required system software. Possible computer/software

architectures are described and the utilization of artificial intelligence techniques is discussed. B.G.

N87-16010# Rockwell International Corp., Duluth, Ga. Missile Systems Div.
PRECISION DELIVERY OF UNGUIDED SUBMUNITIONS FROM A TACTICAL STANDOFF MISSILE
R. D. Ehrich and J. R. Beaty *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986) 17 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

The extension of a low cost tactical weapon to missions involving area targets requires the accurate dispensing of unguided submunitions. For a terminally guided weapon, proportional navigation can no longer be used, since it cannot compensate for the ballistics of the submunition. A terminal guidance algorithm was developed to control the weapon trajectory between the midcourse flight path and the point of dispense. The algorithm incorporates submunition drag characteristics to assure high accuracy. The algorithm also assures adequate arming time for the submunitions and adequate time for the pattern to develop. The second element of accurate submunition delivery is the dispensing or expulsion mechanism, which ejects the payload out of the canister. The ejection mechanism must provide the desired pattern size, shape, and density. Air bag technology is employed to assure satisfactory ejection forces with adequate repeatability. The current study is theoretical in nature, relying on digital simulation to substantiate conclusions on patterns and accuracy. Author

N87-16011# Naval Air Development Center, Warminster, Pa. Aero Analysis Div.
HIGH ALTITUDE, LONG ENDURANCE RPV DESIGN TECHNOLOGY STUDY **c05**
Campbell Henderson, Edward McQuillen, and Larry Lehman *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 14 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

The Naval Air Development Center conducted a design technology study of high altitude long endurance Remotely Piloted Vehicles (RPVs) for possible mission applications which might include surveillance, over the horizon communications, and targeting, among others. Phase 1 was to investigate technology levels and potential technology breakthroughs that can provide vehicle endurance of greater than 100 hours at altitudes greater than 60,000 feet, and to incorporate the technologies into conceptual vehicle designs. Thes results are presented. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N87-16012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCIENCE AND TECHNOLOGY ISSUES IN SPACECRAFT FIRE SAFETY
Robert Friedman and Kurt R. Sacksteder Jan. 1987 29 p Presented at the 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987; sponsored by AIAA
(NASA-TM-88933; E-3349; NAS 1.15:88933; AIAA-87-0467) Avail: NTIS HC A03/MF A01 CSCL 22B

The space station, a permanently-inhabited orbiting laboratory, places new demands on spacecraft fire safety. Long-duration missions may call for more-constrained fire controls, but the accessibility of the space station to a variety of users may call for less-restrictive measures. This paper discusses fire safety issues through a review of the state of the art and a presentation of key findings from a recent NASA Lewis Research Center Workshop. The subjects covered are the fundamental science of low-gravity combustion and the technology advances in fire detection, extinguishment, materials assessment, and atmosphere selection. Key concerns are for the adoption of a fire-safe atmosphere and the substitution for the effective but toxic extinguishant, halon 1301. The fire safety studies and reviews provide several recommendations for further action. One is the expanded research in combustion, sensors, and materials in the low-gravity environment of space. Another is the development of generalized fire-safety standards for spacecraft through cooperative endeavors with aerospace and outside Government and industry sources. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N87-16013# Sandia National Labs., Albuquerque, N. Mex.
MEANINGFUL FM TRANSMITTER MODULATION LINEARITY MEASUREMENTS
H. O. Jeske 1986 7 p Presented at the International Telemetering Conference, Las Vegas, Nev., 13 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-014291; SAND-86-1526C; CONF-8610119-1) Avail: NTIS HC A02/MF A01

The IM products in the demodulator output in this case are due only to the demodulator's transfer characteristics. IM product levels of the test system greater than 60 dB below the simultaneous modulation level of +300 kHz each by 400 and 450 kHz tones are obtained at Sandia Laboratories. The use of two-tone IM tests for the evaluation and specification of FM transmitter modulation linearity is strongly recommended. DOE

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N87-16014*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA/DOD CONTROL/STRUCTURES INTERACTION TECHNOLOGY, 1986
Robert L. Wright, comp. Nov. 1986 549 p Conference held in Norfolk, Va., 18-21 Nov. 1986; sponsored by NASA Langley Research Center and AFWAL
(NASA-CP-2447-Pt-1; L-16242-Pt-1; NAS 1.55:2447-Pt-1) Avail: NTIS HC A23/MF A01 CSCL 22B

Control/structures interactions, deployment dynamics and system performance of large flexible spacecraft are discussed. Spacecraft active controls, deployable truss structures, deployable antennas, solar power systems for space stations, pointing control systems for space station gimballed payloads, computer-aided design for large space structures, and passive damping for flexible structures are among the topics covered. For individual titles, see N87-16015 through N87-16048.

N87-16015*# Ametek, Inc., Anaheim, Calif. Composite Materials and Applications Div.

ADVANCED COMPOSITES FOR LARGE NAVY SPACECRAFT

c24

William E. Davis *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 1-10 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 11D

An overview is given of work conducted on contract for the Naval Sea Systems Command. The objective of this contract was to provide direction for the development of high modulus graphite reinforced metal matrix composites. These advanced materials can have a significant effect on the performance of a spacecraft before, during and after an evasive maneuver. The work conducted on this program was organized into seven technical tasks. Task 1 was development of a generic Navy spacecraft model. Finite element models of candidate structural designs were developed. In Task 2, the finite-element model(s) of the structure were used to conduct analytical assessments involving conventional materials, resin matrix composites and metal matrix composites (MMC). In Task 3 and 4, MMC material design, fabrication and evaluation was conducted. This consisted of generating material designs and developing a data base for a broad range of graphite reinforced MMC materials. All material was procured according to specifications which set material quality and material property standards. In Task 5, a set of evasive maneuvering requirements were derived and used in Task 6 to conduct analytical simulations. These analytical simulations used current SOA material properties and projected material properties to provide an indication of key payoffs for material development. In Task 7, a set of material development recommendations was generated. Author

N87-16016*# Naval Research Lab., Washington, D. C.

N-ROSS: THE DYNAMICS AND CONTROL ISSUES

Robert E. Lindberg *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 11-24 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

The Navy Remote Ocean Sensing System (N-ROSS) Dynamic Stability Study team concluded that the frozen April 1985 design was viable and contained no show stoppers, although it was also clear from the study results that the configuration required further optimization. While the frozen N-ROSS configuration used has since been superceded, and the vehicle is now under competitive procurement, several other results remain from the study that will have lasting value to the N-ROSS program. The importance of constructing an integrated simulation, to serve as a design and verification aid, has been clearly established. The two team approach to the study afforded the Navy a higher degree of confidence in the results than could have been accomplished by a single simulation, and the approach led to results that highlighted subtleties in the model and simulation development that surely would have been overlookded without the benefit of an independent companion simulation with which to compare it. Author

N87-16017*# Air Force Rocket Propulsion Lab., Edwards AFB, Calif. Interdisciplinary Space Technology Branch.

SPACECRAFT DYNAMICS AND CONTROL PROGRAM AT AFRPL

A. Das, L. K. S. Slimak, and W. T. Schloegel *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 25-40 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

A number of future DOD and NASA spacecraft such as the space based radar will be not only an order of magnitude larger in dimension than the current spacecraft, but will exhibit extreme structural flexibility with very low structural vibration frequencies. Another class of spacecraft (such as the space defense platforms) will combine large physical size with extremely precise pointing requirement. Such problems require a total departure from the traditional methods of modeling and control system design of spacecraft where structural flexibility is treated as a secondary effect. With these problems in mind, the Air Force Rocket Propulsion Laboratory (AFRPL) initiated research to develop dynamics and control technology so as to enable the future large space structures (LSS). AFRPL's effort in this area can be subdivided into the following three overlapping areas: (1) ground experiments, (2) spacecraft modeling and control, and (3) sensors and actuators. Both the in-house and contractual efforts of the AFRPL in LSS are summarized. Author

N87-16018*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

FLIGHT DYNAMICS LABORATORY OVERVIEW

Thaddeus Sandford *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 41-65 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

The Flight Dynamics Laboratory (FDL) is one of four Air Force Wright Aeronautical Laboratories (AFWAL) and part of the Aeronautical Systems Division located at Wright-Patterson AFB, Ohio. The FDL is responsible for the planning and execution of research and development programs in the areas of structures and dynamics, flight controls, vehicle equipment/subsystems, and aeromechanics. Some of the areas being researched in the four FDL divisions are as follows: large space structures (LSS) materials and controls; advanced cockpit designs; bird-strike-tolerant windshields; and hypersonic interceptor system studies. Two of the FDL divisions are actively involved in programs that deal directly with LSS control/structures interaction: the Flight Controls Division and the Structures and Dynamics Division. Author

N87-16019*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

ACTIVE CONTROL EVALUATION FOR SPACECRAFT (ACES)

J. Pearson and W. Yuen *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 67-84 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

The Air Force goal is to develop vibration control techniques for large flexible spacecraft by addressing sensor, actuator, and control hardware and dynamic testing. The Active Control Evaluation for Spacecraft (ACES) program will address the Air Force goal by looking at two leading control techniques and implementing them on a structural model of a flexible spacecraft under laboratory testing. The first phase in the ACES program is to review and to assess the High Authority Control/Low Authority Control (HAC/LAC) and Filter accomodated Model Error Sensitivity Suppression (FAMESS) control techniques for testing on the modified VCOSS structure. Appropriate sensors and actuators will be available for use with both techniques; locations will be the same for both techniques. The control actuators will be positioned at the midpoint and free end of the structure. The laser source for the optical sensor is mounted on the feed mast. The beam will be reflected from a mirror on the offset antenna onto the detectors mounted above the shaker table bay. The next phase is to develop an analysis simulation with the control algorithms implemented for dynamics verification. The third phase is to convert the control laws into high level computer language and test them in the NASA-MSFC facility. The final phase is to compile all analytical and test results for performance comparisons. Author

N87-16020*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

PACOSS PROGRAM OVERVIEW AND STATUS

L. C. Rogers and K. E. Richards, Jr. (Martin Marietta Aerospace, Denver, Colo.) *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 85-109 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

Many future civilian and military large space structures (LSS) will have as performance objectives stringent pointing accuracies, short settling times, relatively fast response requirements, or

combinations thereof. Many of these structures will be large, light weight, and will exhibit high structural modal density at low frequency and within the control bandwidth. Although it is possible in principle to achieve structural vibration control through purely active means, experience with complex structures has shown that the realities of plant model inaccuracies and sensor/actuator dynamics frequently combine to produce substandard performance. A more desirable approach is to apply passive damping technology to reduce the active control burden. Development of the technology to apply this strategy is the objective of the PACOSS (Passive and Active Control OF Space Structures) program. A key element in the PACOSS program is the Representative System Article (RSA). The RSA is a generic paper system that serves as a testbed for damping and controls studies. It also serves as a basis for design of the smaller Dynamic Test Article (DTA), a hardware testbed for the laboratory validation of analysis and design practices developed under PACOSS. Author

N87-16021*# General Dynamics Corp., San Diego, Calif. Space Systems Div.

DEPLOYABLE TRUSS STRUCTURE ADVANCED TECHNOLOGY

J. E. Dyer and M. P. Dudeck *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 111-124 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 22B

The 5-meter technology antenna program demonstrated the overall feasibility of integrating a mesh reflector surface with a deployable truss structure to achieve a precision surface contour compatible with future, high-performance antenna requirements. Specifically, the program demonstrated: the feasibility of fabricating a precision, edge-mounted, deployable, tetrahedral truss structure; the feasibility of adjusting a truss-supported mesh reflector contour to a surface error less than 10 mils rms; and good RF test performance, which correlated well with analytical predictions. Further analysis and testing (including flight testing) programs are needed to fully verify all the technology issues, including structural dynamics, thermodynamics, control, and on-orbit RF performance, which are associated with large, deployable, truss antenna structures. Author

N87-16022*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT OF THE LENS ANTENNA DEPLOYMENT DEMONSTRATION (LADD) SHUTTLE-ATTACHED FLIGHT EXPERIMENT c32

H. Hill, D. Johnston, and H. Frauenberger (Grumman Aerospace Corp., Bethpage, N.Y.) *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 125-144 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 20N

The primary objective of the LADD Program is to develop a technology demonstration test article that can be used for both ground and flight tests to demonstrate the structural and mechanical feasibility and reliability of the single-axis roll-out space based radar (SBR) approach. As designed, the LADD will essentially be a generic strucutural experiment which incorporates all critical technology elements of the operational satellite and is applicable to a number of future antenna systems. However, to fully determine its design integrity for meeting the lens flatness and constant geometry requirements in a zero g environment under extreme thermal conditions, the LADD must be space flight tested. By accurately surveying the structure under varying conditions the membrane tolerance-holding capabilities of the structure will be demonstrated. The flight test will provide data to verify analytical tools used to predict thermal and structural behavior. Most important, the experiment will provide an initial indication of structural damping in a zero g vacuum environment. The recently completed Solar Array Flight Experiment (SAFE) showed orbital damping greater than that experienced during ground testing. From the experience and the information obtained from LADD it is hoped that designs can be confidently extrapolated to operational satellites with apertures in the 20 m by 60 m size range. Author

N87-16023*# Martin Marietta Aerospace, Denver, Colo.

BOX TRUSS ANTENNA TECHNOLOGY STATUS c32

J. V. Coyner and E. E. Bachtell *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 145-148 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 20N

Recent technology development activities for box truss structures and box truss antennas are summarized. Three primary activities are discussed: the development of an integrated analysis system for box truss mesh antennae; dynamic testing to characterize the effect of joint free play on the dynamic behavior of box truss structures; and fabrication of a 4.5 meter diameter offset fed mesh reflector integrated to an all graphite epoxy box truss cube. Author

N87-16024*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOLAR DYNAMIC POWER SYSTEMS FOR SPACE STATION c20

Thomas B. Irvine, Marsha M. Nall, and Robert C. Seidel *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 149-166 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 14B

The Parabolic Offset Linearly Actuated Reflector (POLAR) solar dynamic module was selected as the baseline design for a solar dynamic power system aboard the space station. The POLAR concept was chosen over other candidate designs after extensive trade studies. The primary advantages of the POLAR concept are the low mass moment of inertia of the module about the transverse boom and the compactness of the stowed module which enables packaging of two complete modules in the Shuttle orbiter payload bay. The fine pointing control system required for the solar dynamic module has been studied and initial results indicate that if disturbances from the station are allowed to back drive the rotary alpha joint, pointing errors caused by transient loads on the space station can be minimized. This would allow pointing controls to operate in bandwidths near system structural frequencies. The incorporation of the fine pointing control system into the solar dynamic module is fairly straightforward for the three strut concentrator support structure. However, results of structural analyses indicate that this three strut support is not optimum. Incorporation of a vernier pointing system into the proposed six strut support structure is being studied. Author

N87-16025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE 15 METER HOOP-COLUMN ANTENNA DYNAMICS: TEST AND ANALYSIS c32

W. Keith Belvin and Harold H. Edighoffer (Edighoffer, Inc., Newport News, Va.) *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 167-185 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 20N

A 15 meter model of the hoop-column antenna concept has been vibration tested for model characterization and analytical model verification. Linear finite element analysis predicted the global vibration frequencies accurately. Good agreement between analysis and test data was obtained only after the analytical model was refined using static test data. As structures become more flexible, structural properties determined from static data become more accurate and should be used to update analytical models. Global vibration modes are not significantly affected by the surface mesh which permits simplified analytical models to be used for prediction of global behavior. These reduced models are believed sufficient for preliminary design and controls simulations where only global behavior is desired. The mesh modes were highly damped due to the knit mesh used for the reflector surface. These modes were also highly coupled and very difficult to measure in the laboratory. The inability to fully characterize the antenna mesh modes in the laboratory indicates robust methods for active surface vibration suppression will be needed. Fortunately, the surface mesh

exhibits high passive damping which should be beneficial to active control systems. Author

N87-16026*# TRW, Inc., Redondo Beach, Calif.
APPLICATION OF PHYSICAL PARAMETER IDENTIFICATION TO FINITE ELEMENT MODELS **c64**
Allen J. Bronowicki, Michael S. Lukich, and Steven P. Kuritz *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 187-206 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 12A

A time domain technique for matching response predictions of a structural dynamic model to test measurements is developed. Significance is attached to prior estimates of physical model parameters and to experimental data. The Bayesian estimation procedure allows confidence levels in predicted physical and modal parameters to be obtained. Structural optimization procedures are employed to minimize an error functional with physical model parameters describing the finite element model as design variables. The number of complete FEM analyses are reduced using approximation concepts, including the recently developed convoluted Taylor series approach. The error function is represented in closed form by converting free decay test data to a time series model using Prony' method. The technique is demonstrated on simulated response of a simple truss structure. Author

N87-16027*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSOR TECHNOLOGY FOR ADVANCED SPACE MISSIONS **c35**
N. M. Nerheim and R. P. DePaula *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 207-219 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 14B

The capability and applications of two sensors, Spatial, High-Accuracy, Position-Encoding Sensor (SHAPES) and Fiber Optics Rotation Sensor (FORS), for advanced missions are discussed. The multiple target, 3-D position sensing capability of SHAPES meets a critical technology need for many developing applications. A major milestone of the SHAPES task was completed on schedule on May 30, 1986, by demonstrating simultaneous ranging to eight moving targets at a rate of 10 measurements per second. The range resolution to static target was shown to be 25 microns. SHAPES scheduled technology readiness will support the sensor needs of a number of early users. The next phase in the development of SHAPES is to incorporate an angular measurement CCD to provide the full 3-dimensional sensing. A flight unit design and fabrication can be complete by FY89. FORS, with its significant improvement over present technology in lifetime, performance, weight, power, and recurrent cost, will be an important technology for future space systems. Technology readiness will be demonstrated with a FORS brassboard with fully integrated IO chips by FY88. The unique capability of miniature remote sensing heads, connected to a central system, will open up new areas in control and stability of large space structures. This application requires additional study. Author

N87-16028*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1: BEAM DYNAMICS AND CONTROL TECHNOLOGY OVERVIEW **c32**
John L. Allen *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 221-232 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20N

The Control of Flexible Structures (COFS) 1 Project provides the invaluable opportunity to test, validate, and measure the effectiveness of theories, structural concepts, control systems, and flight certification processes for future missions through a research program focusing on multiple issues in large flexible structures, dynamics, and controls. The COFS 1 Project consists of a series of ground and flight activities building progressively from modeling and dynamic characterization of large space systems to the more complex issues of flexible-body control. The program objectives are to: determine the degree to which theory and ground testing can predict flight performance of next-generation low-frequency structures; evaluate structural fidelity of representative next-generation large deployable precision structure; assess math modeling requirements for large lightweight complex systems on which ground test results are questionable; determine degree to which scale model analysis and tests can be correlated to full-scale performance; evaluate system identification and state estimation algorithms on complex lightweight structures in the space environment; evaluate and verify controls/structures modeling capability; evaluate control laws and control systems; and evaluate damping effects in micro-g environment. Author

N87-16029*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1 RESEARCH OVERVIEW **c12**
G. C. Horner *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 233-251 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

The Control of Flexible Structures (COFS) program is divided into three areas of research. These three areas are controls/structures analysis development, ground test experiments, and in-space experiments. The ground test experiments are intended to validate analyses and to confirm through hardware tests our technical readiness to successfully fly the Mast hardware. There is this close relation to the results of ground tests and analytical predictions that must be understood before flight experiments may be attempted. Details relative to each program area are given. Author

N87-16030*# Harris Corp., Palm Bay, Fla.
DESCRIPTION OF THE MAST FLIGHT SYSTEM **c12**
Ronald C. Talcott and John W. Shipley *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 253-263 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

The Mast Flight System is composed of several subsystems. Primary among these is the Deployable Mast Subsystem (DMS) which consists of a beam assembly and an associated mechanism for deploying and retracting the beam. The beam assembly is a joint dominated graphite epoxy and titanium truss as is expected of future large space structures. Integral to the beam assembly are actuators, sensors and associated electronics which are available for excitation and damping as desired by the experimenter. The beam structural characteristics can also be modified as desired by the experimenter using the Parameter Modification Device installed at the end of the beam. Data measured on the beam by the sensors and commands to the actuators are transmitted along the beam digitally at 150 Hz using a standard 1553 type bus. The Modular Distributed Information Subsystem (MDIS) computer functions as bus master and ensures that all experimental data is saved for future analysis. The MDIS computer also performs a safing function to prevent inadvertent overexcitation of the beam. Finally, the Excitation and Damping Subsystem (EDS) computer is available to the experimenter for implementation of control algorithms or any other numerical operations as desired. Data from all system sensors can be accessed by the EDS computer. Author

N87-16031*# Harris Corp., Palm Bay, Fla.
MAST FLIGHT SYSTEM BEAM STRUCTURE AND BEAM STRUCTURAL PERFORMANCE **c39**
David C. Lenzi and John W. Shipley *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 265-279 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

An overall understanding of the beam assembly and data with

which potential experimenters can begin to conduct analyses relevant to their experiments is given. Data is given on the beam structural concept, the tip remote station layout, the intermediate remote station layout with and without actuators, beam element materials, equivalent beam characteristics, beam element properties, remote station mass properties, and MAST Flight System modal characteristics. R.J.F.

N87-16032*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAST FLIGHT SYSTEM DYNAMIC PERFORMANCE c39
L. Davis, D. Hyland, T. Otten, and F. Ham *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 281-298 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

The MAST Flight System as a test bed for large space structure control algorithms is discussed. An overview is given of the control system architecture. The actuators, the sensors, the control computer, and the baseline damping algorithm are discussed. R.J.F.

N87-16033*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAST FLIGHT SYSTEM OPERATIONS c39
M. Larry Brumfield *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 299-317 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

The integration process of the MAST flight system is surveyed. Insight is given into the planned orbital experiment process. The data flow necessary to support the flight operation is outlined. Author

N87-16034*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1 GUEST INVESTIGATOR PROGRAM c12
Anthony Fontana and Robert L. Wright *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 319-325 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22A

The process for selecting guest investigators for participation in the Control of Flexible Structures (COFS)-1 program is described. Contracts and grants will be awarded in late CY87. A straw-man list of types of experiments and a distribution of the experiments has been defined to initiate definition of an experiments package which supports development and validation of control structures interaction technology. A schedule of guest investigator participation has been developed. Author

N87-16035*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 2: 3-D DYNAMICS AND CONTROLS TECHNOLOGY
Jon S. Pyle *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 327-345 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

The Control of Flexible Structures (COFS) 2 project is a complex and ambitious undertaking which will address several critical technology areas. Among them are modeling, structural dynamics, controls, and ground testing issues which are not only germane to this effort, but to other large space structure programs being contemplated. This effort requires the early integration of controls and structural dynamics considerations in order to achieve mission success. Several technology advances must be achieved in the areas of system modelling, control synthesis and methodology, sensor/actuator development, and ground testing techniques for system evaluation and on-orbit performance prediction and verification. This project offers a unique opportunity for the integration of several disciplines to produce technology advances which will benefit many future programs. In addition, the opportunities available to participate in the various levels in the phase of this project, e.g., analytical development and modelling, ground testing, and flight testing, permit for the involvement of a significant number of interested researchers and organizations from government, universities and industry. Author

N87-16036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 3: MULTIBODY DYNAMICS AND CONTROL TECHNOLOGY c39
Robert Letchworth and Paul E. McGowan *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 347-370 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

COFS 3 is the third project within the Control of Flexible Structures (COFS) program. It deals with developing multibody dynamics and control technology for large space structures. It differs from COFS 1 and 2 in two respects. First, it addresses a more complex class of structure, and second it is basically a scale model ground test and analysis program while COFS 1 and 2 feature Shuttle flight experiments. The specific technology thrusts within COFS 3 are model sensitivities, test methods, analysis validation, systems identification, and vibration suppression. The COFS 3 project will develop the methods for using dynamically scaled models and analysis to predict the structural dynamics of large space structures. The project uses the space station as a focus because it is typical of the structures of interest and provides the first opportunity to obtain full-scale on-orbit dynamics data. Author

N87-16037*# General Electric Co., Philadelphia, Pa. Space Div.
CONCEPTUAL DESIGN OF POINTING CONTROL SYSTEMS FOR SPACE STATION GIMBALLED PAYLOADS
Robert O. Hughes *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 371-381 Previously announced as A86-47411 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

A conceptual design of the control system for Payload Pointing Systems (PPS) is developed using classic Proportional-Integral-Derivatives (PID) techniques. The major source of system pointing error is due to the disturbance-rich environment of the space station in the form of gimbal baseplate motions. These baseplate vibrations are characterized using Fast Fourier Transform (FFT) techniques. Both time domain and frequency domain dynamic models are developed to assess control system performance. Three basic methods exist for the improvement of PPS pointing performance: increase control system bandwidth, add Image Motion Compensation, and/or reduce (or change) the baseplate disturbance environment. Author

N87-16038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN CONSIDERATIONS FOR JOINTS IN DEPLOYABLE SPACE TRUSS STRUCTURES c39
Marvin D. Rhodes *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 383-398 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

All of the structures considered for the Control of Flexible Structures (COFS) flight experiments are deployable truss structures and their response will be dominated by the structural response of the joints. To prepare for these experiments some fundamental research work is being conducted in the Structures and Dynamics Division at LaRC which will provide insight into structurally efficient and predictable deployable truss joints. This work involves generic studies of the static and dynamic response of joints as well as the development of analytical models which can be used to predict the response of a large multijointed truss. In addition to the generic joint studies, the research effort encompasses the design and fabrication of a 20-meter long deployable truss beam for laboratory evaluation of its structural characteristics and correlation with developed prediction methods. The experimental results have indicated the importance of attention to detail in the design and fabrication of joints for deployable

truss structures. The dimensional relations and material considerations for efficient pin-clevis joints have been outlined. Results of tests on the near-center latch are discussed. Author

N87-16039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF MODAL IDENTIFICATION TECHNIQUES USING A HYBRID-DATA APPROACH c39
Richard S. Pappa *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 399-417 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

Modal identification of seemingly simple structures, such as the generic truss is often surprisingly difficult in practice due to high modal density, nonlinearities, and other nonideal factors. Under these circumstances, different data analysis techniques can generate substantially different results. The initial application of a new hybrid-data method for studying the performance characteristics of various identification techniques with such data is summarized. This approach offers new pieces of information for the system identification researcher. First, it allows actual experimental data to be used in the studies, while maintaining the traditional advantage of using simulated data. That is, the identification technique under study is forced to cope with the complexities of real data, yet the performance can be measured unquestionably for the artificial modes because their true parameters are known. Secondly, the accuracy achieved for the true structural modes in the data can be estimated from the accuracy achieved for the artificial modes if the results show similar characteristics. This similarity occurred in the study, for example, for a weak structural mode near 56 Hz. It may even be possible--eventually--to use the error information from the artificial modes to improve the identification accuracy for the structural modes. Author

N87-16040*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SYSTEM IDENTIFICATION FOR MODELING FOR CONTROL OF FLEXIBLE STRUCTURES
Edward Mettler and Mark Milman *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 419-429 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

The major components of a design and operational flight strategy for flexible structure control systems are presented. In this strategy an initial distributed parameter control design is developed and implemented from available ground test data and on-orbit identification using sophisticated modeling and synthesis techniques. The reliability of this high performance controller is directly linked to the accuracy of the parameters on which the design is based. Because uncertainties inevitably grow without system monitoring, maintaining the control system requires an active on-line system identification function to supply parameter updates and covariance information. Control laws can then be modified to improve performance when the error envelopes are decreased. In terms of system safety and stability the covariance information is of equal importance as the parameter values themselves. If the on-line system ID function detects an increase in parameter error covariances, then corresponding adjustments must be made in the control laws to increase robustness. If the error covariances exceed some threshold, an autonomous calibration sequence could be initiated to restore the error enveloped to an acceptable level. Author

N87-16041*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT AND USE OF A LINEAR MOMENTUM EXCHANGE DEVICE c14
George B. Doane, III (Control Dynamics Co., Huntsville, Ala.), Henry Waites, and G. David Edgemon *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 431-440 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 14B

In 1981 the Marshall Space Flight Center (MSFC) began establishing an inhouse facility for testing control concepts to be applied to Large Space Structures (LSS). The original concept called for a long flexible beam suspended from the ceiling by a low friction support system. The lower end of the beam was to be mounted to the Advanced Gimbal System (AGS). Analysis and system engineering soon showed that a more tenable design would be where the whole system was inverted, i.e., the AGS hung from the ceiling with the beam hanging down from it. While this configuration, augmented by a base excitation table (RET) was being built, an ASTROMAST obtained from the Jet Propulsion Laboratory was extended, analyzed and tested. From that basic configuration was evolved the cruciform, VCOSS and ACES configurations as shown. The addition of the cruciform added low frequency nested modes and the additional instrument package at the tip contains gyros to monitor tip motion. Author

N87-16042*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTER-AIDED DESIGN AND DISTRIBUTED SYSTEM TECHNOLOGY DEVELOPMENT FOR LARGE SPACE STRUCTURES
Ernest S. Armstrong and Suresh M. Joshi *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 441-456 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

Proposed large space structures have many characteristics that make them difficult to analyze and control. They are highly flexible, with components mathematically modeled by partial differential equations or very large systems of ordinary differential equations. They have many resonant frequencies, typically low and closely spaced. Natural damping may be low and/or improperly modeled. Coupled with stringent operational requirements of orientation, shape control, and vibration suppression, and the inability to perform adequate ground testing, these characteristics present an unconventional identification and control design problem to the systems theorist. Some of the research underway within Langley's Spacecraft Control Branch, Guidance and Control Division aimed at developing theory and algorithms to treat large space structures systems identification and control problems is described. The research areas to be considered are computer-aided design algorithms, and systems identification and control of distributed systems. Author

N87-16043*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DISTRIBUTED CONTROL FOR COFS 1
R. C. Montgomery, Jeff Sulla (PRC Kentron, Inc., Hampton, Va.), and D. K. Lindner (Virginia Polytechnic Inst. and State Univ., Blacksburg) *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 457-473 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

An overview is given of the work being done at NASA LaRC on developing the Control of Flexible Structures (COFS) 1 Flight Experiment Baseline Control Law. This control law currently evolving to a generic control system software package designed to supply many, but not all, guest investigators. A system simulator is also described. It is currently being developed for COFS-1 and will be used to develop the Baseline Control Law and to evaluate guest investigator control schemes. It will be available for use whether or not control schemes fall into the category of the Baseline Control Law. First, the hardware configuration for control experiments is described. This is followed by a description of the simulation software. Open-loop sinusoid excitation time histories are next presented both with and without a local controller for the Linear DC Motor (LDCM) actuators currently planned for the flight. The generic control law follows and algorithm processing requirements are cited for a nominal case of interest. Finally, a closed-loop simulation study is presented, and the state of the work is summarized in the concluding remarks. Author

N87-16044*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PASSIVE DAMPING AUGMENTATION FOR FLEXIBLE STRUCTURES
J. R. Sesak, M. J. Gronet, and G. M. Marinos *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 475-493 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

The present work concentrates on the application and extension of absorber design and optimization techniques to a multimode, multi-DOF, large space structure, namely the NASA space station. The principal issue addressed is the optimal tuning of several absorbers for the transient response of a multi-DOF system, including the effects of modal coupling, existing structural damping, absorber placement, and adsorber mass. The space station is subject to many transient disturbances such as docking, orbit reboost, crew motion, and payload slewing. A notable steady-state excitation source is the Science Research Centrifuge, which rotates at a frequency in the bandwidth of the primary structural modes. Because of the relatively advanced state of development of steady-state absorber design techniques, only the transient cases are considered in this study. Author

N87-16045*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIDISCIPLINARY ANALYSIS OF ACTIVELY CONTROLLED LARGE FLEXIBLE SPACECRAFT
Paul A. Cooper, John W. Young, and Thomas R. Sutter *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 495-514 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

The control of Flexible Structures (COFS) program has supported the development of an analysis capability at the Langley Research Center called the Integrated Multidisciplinary Analysis Tool (IMAT) which provides an efficient data storage and transfer capability among commercial computer codes to aid in the dynamic analysis of actively controlled structures. IMAT is a system of computer programs which transfers Computer-Aided-Design (CAD) configurations, structural finite element models, material property and stress information, structural and rigid-body dynamic model information, and linear system matrices for control law formulation among various commercial applications programs through a common database. Although general in its formulation, IMAT was developed specifically to aid in the evaluation of the structures. A description of the IMAT system and results of an application of the system are given. Author

N87-16046*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS AND SIMULATION OF THE MAST (COFS-1 FLIGHT HARDWARE) c19
Lucas G. Horta, Joanne L. Walsh, Garnett C. Horner, and James P. Bailey (PRC Kentron, Inc., Hampton, Va.) *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 515-532 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

In-house analysis work in support of the Control of Flexible Structures (COFS) program is being performed at the NASA Langley Research Center. The work involves evaluation of the proposed design configuration, controller design as well as actuator dynamic modeling, and MAST/actuator dynamic simulation of excitation and damping. A complete finite element model of the MAST has been developed. This finite element model has been incorporated into an optimization procedure which minimizes total mass while maintaining modal coupling. Results show an increase in the total mass due to additional constraints (namely, the diagonal frequency constraint) imposed on the baseline design. A valid actuator dynamic model is presented and a complete test sequence of the proposed flight experiment is demonstrated. The actuator dynamic model is successfully used for damping and the stroke limitations for first mode excitation are demonstrated. Plans are to incorporate additional design variables and constraints into the optimization procedure (such as actuator location) and explore alternative formulations of the objective function. A different actuator dynamic model to include hardware limitations will be investigated. Author

N87-16047*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SURFACE CONTROL SYSTEM FOR THE 15 METER HOOP-COLUMN ANTENNA
James B. Miller, Elvin L. Ahl, Jr., David H. Butler, and Frank Perl, Jr. *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 533-545 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

The 15-meter hoop-column antenna fabricated by the Harris Corporation under contract to the NASA Langley Research Center is described. The antenna is a deployable and restowable structure consisting of a central telescoping column, a 15-meter-diameter folding hoop, and a mesh reflector surface. The hoop is supported and positioned by 48 quartz cords attached to the column above the hoop, and by 24 graphite cords from the base of the antenna column. The RF reflective surface is a gold plated molybdenum wire mesh supported on a graphite cord truss structure which is attached between the hoop and the column. The surface contour is controlled by 96 graphite cords from the antenna base to the rear of the truss assembly. The antenna is actually a quadaperture reflector with each quadrant of the surface mesh shaped to produce an offset parabolic reflector. Results of near-field and structural tests are given. Controls structures and electromagnetics interaction, surface control system requirements, mesh control adjustment, surface control system actuator assembly, surface control system electronics, the system interface unit, and control stations are discussed. Author

N87-16048*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ROBUST MULTIVARIABLE CONTROLLER DESIGN FOR FLEXIBLE SPACECRAFT
Suresh M. Joshi and Ernest S. Armstrong *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 547-562 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

Large, flexible spacecraft are typically characterized by a large number of significant elastic modes with very small inherent damping, low, closely spaced natural frequencies, and the lack of accurate knowledge of the structural parameters. Summarized here is some recent research on the design of robust controllers for such spacecraft, which will maintain stability, and possible performance, despite these problems. Two types of controllers are considered, the first being the linear-quadratic-Gaussian-(LQG)-type. The second type utilizes output feedback using collocated sensors and actuators. The problem of designing robust LQG-type controllers using the frequency domain loop transfer recovery (LTR) method is considered, and the method is applied to a large antenna model. Analytical results regarding the regions of stability for LQG-type controllers in the presence of actuator nonlinearities are also presented. The results obtained for the large antenna indicate that the LQG/LTR method is a promising approach for control system design for flexible spacecraft. For the second type of controllers (collocated controllers), it is proved that the stability is maintained in the presence of certain commonly encountered nonlinearities and first-order actuator dynamics. These results indicate that collocated controllers are good candidates for robust control in situations where model errors are large. Author

N87-16049*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A NORMAL INCIDENCE X-RAY TELESCOPE SOUNDING ROCKET PAYLOAD
Leon Golub Jan. 1987 24 p
(Grant NAG5-626)
(NASA-CR-180109; NAS 1.26:180109; SAPR-3; SAPR-4; SAPR-5)
Avail: NTIS HC A02/MF A01 CSCL 22B

Launch preparation, flight, and payload recovery, prefilter performance analysis, and corrective actions were discussed. B.G.

N87-16050*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DYNAMIC ANALYSIS OF THE LARGE DEPLOYABLE REFLECTOR
Robert E. Calleson and A. Don Scott Jan. 1987 34 p
(NASA-TM-89056; NAS 1.15:89056) Avail: NTIS HC A03/MF A01 CSCL 22B

The Large Deployable Reflector (LDR) is to be an astronomical observatory orbiting above Earth's obscuring atmosphere and operating in the spectral range between 30 microns and 1000 microns wavelength. The LDR will be used to study such astronomical phenomena as stellar and galactic formation, cosmology, and planetary atmospheres. The LDR will be the first observatory to be erected and assembled in space. This distinction brings with it several major technological challenges such as the development of ultra-lightweight deployable mirrors, advanced mirror fabrication techniques, advanced structures, and control of vibrations due to various sources of excitation. The purpose of this analysis is to provide an assessment of the vibrational response due to secondary mirror chopping and LDR slewing. The dynamic response of two 20-m LDR configurations was studied. Two mirror support configurations were investigated for the Ames concept, the first employs a six-strut secondary mirror support structure, while the second uses a triple-bipod support design. All three configurations were modeled using a tetrahedral truss design for the primary mirror support structure. Response resulting from secondary mirror chopping was obtained for the two Ames configurations, and the response of the primary mirror from slewing was obtained for all three configurations. Author

N87-16051# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A METHODOLOGY FOR SELECTION OF A SATELLITE SERVICING ARCHITECTURE, VOLUME 2 Final Report, Dec. 1984 - Dec. 1985
Jeffrey W. Anderson, Mark S. Gibson, Delbert B. Langerock, Richard A. Lieber, and Michael A. Palmer Dec. 1985 285 p
(AD-A172441; AFIT/GSE/ENY/85D-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 15/5

A two-phase methodology for selecting an optimal military satellite servicing system is developed using the systems engineering approach. This methodology is used to evaluate several alternative systems at varying levels of detail. The candidate systems are composed of Low-G launchers, high G launchers, orbital servicing vehicles, and space bases. An optimal realization is then derived for a system of low G launchers and orbital servicing vehicles. In the first phase of the approach, vector optimization techniques are used to vary the states of a model to obtain a set of optimal solutions. The second phase embodies the decision maker's preferences in a value system to enable preference ranking of the optimal solutions in the non-dominated solution set. This methodology, as presented, can be applied to any complex problem with multiple conflicting objectives. It is designed for use by an engineering organization supporting a senior level decision maker. GRA

N87-16052# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A METHODOLOGY FOR SELECTION OF A SATELLITE SERVICING ARCHITECTURE. VOLUME 1: EXECUTIVE SUMMARY M.S. Thesis
Jeffrey W. Anderson, Mark S. Gibson, Delbert B. Langerock, Richard A. Lieber, and Michael A. Palmer Dec. 1985 69 p
(AD-A172477; AFIT/GSE/ENY/85D-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 15/5

This study outlined a methodology to select a satellite servicing system and evaluated several initial system concepts. Future efforts to design and evaluate more detailed system concepts may build upon this study. The primary recommendation is to continue the application of the two phase systems engineering methodology to the alternative systems developed and modeled in the systems synthesis step. As these were preliminary models, there is insufficient detail to implement the systems identified, so additional refinements of the model are necessary. These refinements should address inclusion of additional performance indices, distinquish between mobile and fixed low G launch vehicles, improve the orbital mechanics relations, improve the representation of manned vs automated servicing, and improve the representation of life support requirements. Additionally, the value system needs refinement, such as incorporation of a more detailed objective hierarchy, and solicitation of high level decision maker preferences. GRA

N87-16053# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A METHODOLOGY FOR SELECTION OF A SATELLITE SERVICING ARCHITECTURE. VOLUME 3: APPENDICES M.S. Thesis
Jeffrey W. Anderson, Mark S. Gibson, Delbert B. Langerock, Richard A. Lieber, and Michael A. Palmer Dec. 1985 118 p
(AD-A172478; AFIT/GSE/ENY/85D-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 15/5

A two phase methodology developed to permit selection of an optimal military satellite servicing system is explained. This volume (3) of a three volume report contains appendices which detail important aspects of the main document. Some of the important aspects are: Satisfaction of mutual preferential independence among the attributes of an objective tree is a necessary and sufficient condition for using an additive value function; Detailed hierarchy of objectives for selection of a satellite servicing system; Computer program for calculation of figures of merit using linear value functions; Model equations; and Listing and sample output for computer program VORBCS F. E.R.

N87-16054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A REVIEW OF AERODYNAMIC CHARACTERISTICS FOR SEVERAL RECOVERY SCHEMES OF REENTRY VEHICLES
Zhicheng Huang 18 Sep. 1986 29 p Transl. into ENGLISH from Kongqidongjixue Xuebao (China), v. 4, no. 1, Mar. 1986 p 88-98 Original language document was announced as A86-32997
(AD-A172993; FTD-ID(RS)T-0733-86) Avail: NTIS HC A03/MF A01 CSCL 22/3

This paper conducts analysis and comparison of the aerodynamic characteristics for several recovery schemes of reentry vehicles. These schemes include the aft jettison mass plus parachutes, the sidewise jettison mass-drag cones plus parachutes, the towed cones plus parachutes, the drag brakes plus parachutes, and the aft jettison mass-drag brakes plus parachutes. The features of pattern of air flow for these schemes, the results of wind tunnel tests and the results of engineering calculation are emphasized. Based on this, a ballistic analysis and performance comparison for these schemes are carried out, and suggestions for the selection of schemes and further work are proposed. GRA

N87-16055# McIntosh Structural Dynamics, Inc., Palo Alto, Calif.
INVESTIGATION OF INTERACTIVE STRUCTURAL AND CONTROLLER SYNTHESIS FOR LARGE SPACECRAFT Final Report, 1 Mar. 1984 - 30 Oct. 1985
Samuel C. McIntosh, Jr. and Michel A. Floyd 22 Jan. 1986 45 p Prepared in cooperation with Integrated Systems, Inc.
(Contract F49620-84-C-0025)
(AD-A172811; TR-86-1; AFOSR-86-0900TR) Avail: NTIS HC A03/MF A01 CSCL 22/2

A technique is developed for least-weight optimal design of a tubular-truss space structure, subject to constraints on its natural frequencies and its open-loop disturbance-rejection properties. The disturbance-rejection properties of the structure are measured by disturbance-to-regulated-variable grammians. It is shown how this technique can be embedded in a model-reduction scheme based on internal balancing. Examples treated include a simple dumbell model and csdl model no. 1. Author (GRA)

N87-16056# Massachusetts Univ., Amherst. Dept. of Civil Engineering.
PARAMETRIC INVESTIGATION OF FACTORS INFLUENCING THE MECHANICAL BEHAVIOR OF LARGE SPACE STRUCTURES Final Technical Report, 1 Nov. 1982 - 30 Jun. 1985
William A. Nash and Thomas J. Lardner 30 May 1986 451 p
(Grant AF-AFOSR-0025-83)
(AD-A172880; AFOSR-86-0858TR) Avail: NTIS HC A20/MF A01 CSCL 22/2

The investigation has two objectives: (1) To investigate the relative importance of factors such as thermal gradients, differential gravitational effects, solar radiation pressure, albedo effects, and spatial pressure gradients on structural behavior of large space structures; and (2) To investigate structural behavior of a very thin membrane subject to combined internal pressure as well as mechanical and thermal loadings. GRA

N87-16057# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering.
THERMAL ASPECTS OF FUTURE SPACECRAFT THERMAL MANAGEMENT SYSTEMS Interim Report, 1 Jan. 1984 - 1 Oct. 1985
John W. Sheffield and Raghav P. Kher Jul. 1986 78 p
(Contract F33615-81-C-2058)
(AD-A173719; AFWAL-TR-86-2021) Avail: NTIS HC A05/MF A01 CSCL 22/2

This report addresses the conceptual design of spacecraft thermal management systems (SCTMS) and their components to provide a basis for the development and implementation of future technologies. In the analysis, components of the SCTMS include: heat pipes, latent thermal energy storage materials, radiators and other thermal structures. The design problem becomes one of selecting a combination of these components subject to both spacecraft mission and launch requirements. To assist in this design process, a knowledge-based software has been developed in the artificial intelligence programming language, PROLOG. This software serves as a design assistant for the development of SCTMS. It supports facilities such as database retrieval, numerical computation, and logical decision making. With these features one can automatically consider all relevant combinations of components, technologies, and materials for the design problem. The goal has been to duplicate, wherever possible, the decision processes of an experienced designer by putting significant decision making, search, and retrieval facilities at his or her disposal. Other objectives were to determine the capabilities of the phase change materials (PCMs) selected by the knowledge-based system. Tests were carried to evaluate properties and thermal behavior of a PCM in pellet form. Two types of PCMs demonstrated potential for SCTMS were calcium chloride hexahydrate and the form stable crystalline polymer, high density polyethylene. GRA

N87-16058# American Society of Civil Engineers, New York.
IDENTIFICATION OF LARGE SPACE STRUCTURES ON ORBIT Final Report, Sep. 1985 - Aug. 1986
Eugene Denman, Timothy Hasselman, C. T. Sun, Jer-Nan Juang, and John Junkins Sep. 1986 356 p
(Contract F04611-85-C-0092)
(AD-A173756; AFRPL-TR-86-054) Avail: NTIS HC A16/MF A01 CSCL 22/1

The aspects of state of the practice modeling and identification of large space structures are discussed in this report. Methods of modeling a structures as well as identification procedures are presented along with data acquisition and processing requirements. Recommendations for developing algorithms for the task of space structure identification are given. GRA

N87-16059# Lockheed Missiles and Space Co., Palo Alto, Calif.
WAVE DISPERSION MECHANISMS IN LARGE SPACE STRUCTURES Final Report, Oct. 1983 - Oct. 1985
K. C. Park 25 Nov. 1985 7 p
(Contract F49620-83-C-0018)
(AD-A173967; LMSC-F104499; AFOSR-86-1007TR) Avail: NTIS HC A02/MF A01 CSCL 22/2

This report describes an investigation into wave dispersion phenomena in large lattice space structures. Particula: results were: (1) That local member dynamic characteristics significantly influence global dynamic response; (2) That it is possible to increase dispersion of wave energy in lattice-truss structures by adopting a nonuniform lattice construction; and (3) That local member dynamics characteristics require detailed modeling techniques which are capable of capturing member bending behavior in order to assess, realistically, the influence of local phenomena on global dynamic response. GRA

N87-16060# Los Alamos National Lab., N. Mex.
BUMPER SHIELD ANALYSIS
A. T. Oyer Jul. 1986 36 p
(Contract W-7405-eng-36)
(DE86-014878; LA-10788-MS) Avail: NTIS HC A03/MF A01

To initially examine the effectiveness of a shield surrounding a reentry vehicle, we used the hypervelocity hydrodynamic impact code, LASOIL. We completed a four-by-four matrix of 16 two-dimensional numerical impact simulations of 1-g tungsten cylinders striking circular plates. The variable parameters were the projectile impact velocity (10, 20, 40, and 80 km/s) and the plate thickness (1, 2, 4, and 8 mm). In each case, the projectile was destroyed in the impact. The shield was penetrated but retained neglible momentum from the impact. The resultant debris cloud was low-density debris and vapor. DOE

N87-16061# Oak Ridge National Lab., Tenn.
SHIELDING OF MANNED SPACE STATIONS AGAINST VAN ALLEN BELT PROTONS: A PRELIMINARY SCOPING STUDY
R. T. Santoro, R. G. Alsmiller, Jr., J. M. Barnes, and J. M. Corbin Sep. 1986 39 p
(Contract DE-AC05-84OR-21400)
(DE87-001586; ORNL/TM-10040) Avail: NTIS HC A03/MF A01

Calculated results are presented to aid in the design of the shielding required to protect astronauts in a space station that is orbiting through the Van Allen proton belt. The geometry considered - a spherical shell shield with a spherical tissue phantom at its center - is only a very approximate representation of an actual space station, but this simple geometry makes it possible to consider a wide range of possible shield materials. Both homogeneous and laminated shields are considered. Also, an approximation procedure - the equivalent thickness approximation - that allows dose rates to be estimated for any shield material or materials from the dose rates for an aluminum shield is presented and discussed. DOE

N87-15989# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT, STATUS, PROSPECTS OF MARINE OBSERVATION SATELLITE
Kohei Arai *In its* Japan report: Science and Technology (JPRS-JST-86-018) 2 Jul. 1986 p 25-40 Transl. into ENGLISH from Kaiyo Kagaku (Tokyo, Japan), Aug. 1985 p 510-516 (For primary document see N87-15987 08-12)
Avail: NTIS HC A05/MF A01

N87-16322*# Messerschmitt-Boelkow-Blohm/Entwicklungsring Nord, Bremen (West Germany).
DESIGN AND DEVELOPMENT OF A TELESCOPIC AXIAL BOOM
Roland Felkai *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 1-12 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 22B

N87-16323*# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
EXTENDABLE RETRACTABLE TELESCOPIC MAST FOR DEPLOYABLE STRUCTURES
M. Schmid and M. Aguirre (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 13-29 (For primary

document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 22B

N87-16766*# Alabama Univ., Huntsville. Dept. of Mathematics.
STOCHASTIC MODELING AND CONTROL SYSTEM DESIGNS OF THE NASA/MSFC GROUND FACILITY FOR LARGE SPACE STRUCTURES: THE MAXIMUM ENTROPY/OPTIMAL PROJECTION APPROACH
Wei-Shen Hsia *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 13 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22B

N87-16781*# Tri-State Univ., Angola, Ind. Dept. of Mechanical and Aerospace Engineering.
TETHER CRAWLER SYSTEM
Frank R. Swanson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 27 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N87-16062*# Scripps Institution of Oceanography, La Jolla, Calif. Space Inst.
CALIBRATION OF NOAA-7 AVHRR, GOES-5 AND GOES-6 VISSR/VAS SOLAR CHANNELS Final Technical Report, 1 Feb. 1985 - 31 Jan. 1986
R. Frouin and C. Gautier Aug. 1986 57 p
(Grant NAGw-697)
(NASA-CR-180103; NAS 1.26:180103; CARS-005) Avail: NTIS HC A04/MF A01 CSCL 22A

The NOAA-7, GOES-5 and GOES-6 Visible Infrared Spin Scan Radiometer/Vertical Atmospheric Sounder (VISSR/VAS) solar channels were calibrated. The White Sands Monument area in New Mexico, whose reflectance properties are well known, and space are used as calibration targets. The shortwave reflected terrestrial irradiance that is measured at satellite altitude is computed using a fairly accurate radiative transfer model which accounts for multiple scattering and bidirectional effects. The ground target reflectance and relevant characteristics of the overlying atmosphere are estimated from climatological data and observation at the nearest meteorological sites. The approach is believed to produce accuracies of 8 to 13% depending on the channel considered. Author

N87-16063# Air Force Geophysics Lab., Hanscom AFB, Mass.
SPACE RADIATION DOSIMETER SSJ FOR THE BLOCK 55D/FLIGHT 7 DMSP (DEFENSE METEOROLOGICAL SATELLITE PROGRAM) SATELLITE: CALIBRATION AND DATA PRESENTATION, ENVIRONMENTAL RESEARCH PAPERS
M. S. Gussenhoven, R. C. Filz, K. A. Lynch, E. G. Mullen, and F. A. Hanser (Panametrics, Inc., Waltham, Mass.) 20 Mar. 1986 547 p
(AD-A172178; AFGL-TR-86-0065; AFGL-ERP-949) Avail: NTIS HC A23/MF A01 CSCL 04/1

The DMSP/F7 satellite carries, in addition to weather monitoring devices, a number of instruments that measure the space environment for the purpose of scientific study. These are an auroral imaging device, precipitating electron and ion detectors, a thermal plasma analyzer, a fluxgate magnetometer, and a space radiation dosimeter. Together, these provide a strong tool for analyzing the high latitude, near-Earth, magnetospheric environment. This report has been prepared to facilitate the use of the data from one of these instruments, the space radiation dosimeter, and to show the data can be used to obtain both dose and flux measurements of high energy relativtic electrons and protons at low altitudes. The report includes: a description of the DMSP/F7 orbit; a description of the space radiation dosimeter and the data it returns; the method by which dose is determined; the method by which flux is determined; and a discussion of the use of high threshold energy proton and ion induced star counts. Appendices A and B present the response of the dosimeter to electron bremsstrahlung and a list of the interactive routines available at AFGL for data analysis. GRA

N87-16046*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS AND SIMULATION OF THE MAST (COFS-1 FLIGHT HARDWARE)
Lucas G. Horta, Joanne L. Walsh, Garnett C. Horner, and James P. Bailey (PRC Kentron, Inc., Hampton, Va.) *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 515-532 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 22B

N87-16481# Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
DEFINITION STUDY AND IMPACT ANALYSIS OF A MICROWAVE RADIOMETER ON A GEOSTATIONARY SPACECRAFT
A. Chedin, D. Pick (Meteorological Office, Bracknell (England).), and R. Rizzi (Bologna Univ. (Italy).) *In* ESA Second Generation Meteosat Definition Studies on Microwave and Infrared Vertical Sounders Sep. 1986 p 5-45 (For primary document see N87-16480 08-47)
Avail: NTIS HC A06/MF A01; ESA, Paris, France FF 100 ($15) Member States, AU, CN, and NO (+20% others)

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N87-16064 Alabama Univ., Huntsville.
THE ANALYSIS AND DESIGN OF PROPULSION SYSTEM EMPLOYING SCARFED NOZZLES Ph.D. Thesis
Jay S. Lilley 1986 454 p
Avail: Univ. Microfilms Order No. DA8619064

An investigation into the analysis and design of propulsion systems employing side exhausting scarfed nozzles was conducted. An axisymmetric, method of characteristics performance analysis model for scarfed nozzles is presented. The results of an extensive parametric study generated by the performance model is presented. The results of this study demonstrate the influence of nozzle geometric parameters on the performance of scarfed nozzles. A simple one dimensional performance analysis model is presented. Comparisons between the results produced by the one dimensional model and those produced by a two dimensional model are presented. Comparison between performance predictions and experimental data are presented to demonstrate the accuracy of the two dimensional model and the limits of its ability. A second parametric study was conducted to evaluate the application of scarfed nozzles in propulsion systems. A scarfed nozzle design methodology based on this second study is presented. Dissert. Abstr.

N87-16065*# Sverdrup Technology, Inc., Cleveland, Ohio.
POTENTIAL PROPELLANT STORAGE AND FEED SYSTEMS FOR SPACE STATION RESISTOJET PROPULSION OPTIONS Final Report
Clayton H. Bader Jan. 1987 63 p
(Contract NAS3-24105)
(NASA-CR-179457; E-3366; NAS 1.26:179457) Avail: NTIS

HC A04/MF A01 CSCL 21H

The resistojet system has been defined as part of the baseline propulsion system for the initial Operating Capability Space Station. The resistojet propulsion module will perform a reboost function using a wide variety of fluids as propellants. There are many optional propellants and propellant combinations for use in the resistojet including (but not limited to): hydrazine, hydrogen, oxygen, nitrogen, water, carbon dioxide, and methane. Many different types of propulsion systems have flown or have been conceptualized that may have application for use with resistojets. This paper describes and compares representative examples of these systems that may provide a basis for space station resistojet system design. Author

N87-16066# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN ECONOMIC FEASIBILITY STUDY ON THE SPACE-BASED PRODUCTION OF METHANE GAS FROM HUMAN WASTE THROUGH ANAEROBIC DIGESTION FOR USE AS AN ORBIT MAINTENANCE PROPELLANT M.S. Thesis

Coral C. Fallstead Dec. 1985 149 p

(AD-A172496; AFIT/GSO/ENS/85D-8) Avail: NTIS HC A07/MF A01 CSCL 22/2

This project explores the economic feasibility of creating fuel energy in space from human waste with application toward space station orbit maintenance. The energy generating concept proposed in this study is anaerobic digestion. This process has four benefits for space application: (1) it can stabilize human waste products, (2) it can reduce solid wastes, (3) it can provide a fairly clear effluent for water recovery, and (4) it can provide a fuel in the form of a gas. The analysis is dependent upon a predetermined scenario defining the input load to the digester system and the size of the spacecraft. The size, shape, and altitude of the vehicle determine the atmospheric drag which must be opposed to maintain the orbit. The basic elements of the study involve: (1) simulation analysis of biochemistry, (2) thermochemical analysis, and (3) cost analysis using the Monte Carlo method. An alternative system to which the digester is compared is transport of conventional propellants from Earth. This alternative does not consider a replacement of the anaerobic digester with some other system to stabilize the waste products of the space station, or the additional benefits of the anaerobic digester listed above. The results of this study show a statistically significant advantage of the digester system over transported conventional propellants due to the high cost of space transportation. GRA

N87-16067# Naval Postgraduate School, Monterey, Calif.

PARTICULATE SIZING IN A SOLID-PROPELLANT ROCKET MOTOR USING LIGHT SCATTERING TECHNIQUES M.S. Thesis

Kevin G. Horton Jun. 1986 66 p

(AD-A174170) Avail: NTIS HC A04/MF A01 CSCL 21/9

An experimental investigation was conducted to determine the feasibility of introducing particles of a known mean diameter into a small solid propellant rocket motor and measuring the change in mean diameter across the exhaust nozzle. Light scattering profiles at small forward angles were recorded at the entrance and exit of the nozzle. The propellant used was nonmetallized and contained HYPB and ammonium perchlorate. Promising results were obtained for injections of polydispersions of glass beads and aluminum oxide particles. GRA

N87-16068# Lawrence Livermore National Lab., Calif.

APPLICATION OF A HEAT PUMP-REFRIGERATOR TO ICF SPACE PROPULSION

J. H. Pitts 29 Jul. 1986 8 p

(Contract W-7405-eng-48)

(DE87-000714; UCID-20858) Avail: NTIS HC A02/MF A01

Lasers proposed for use with ICF space propulsion have high efficiency only at low temperature. Yet waste heat energy can only be radiated effectively at high temperature because radiator area is inversely proportional to the fourth power of the absolute temperature. Darling suggested that a heat pump-refrigerator be used to transfer waste heat from a laser, operating at a low temperature, to a high temperature radiator. If heat could be transferred efficiently with a heat pump-refrigerator, savings in weight and cost could be gained when compared to directly radiating waste heat at the laser temperature. DOE

N87-16024*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOLAR DYNAMIC POWER SYSTEMS FOR SPACE STATION

Thomas B. Irvine, Marsha M. Nall, and Robert C. Seidel *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 149-166 (For primary document see N87-16014 08-18)

Avail: NTIS HC A23/MF A01 CSCL 14B

N87-16180# Joint Publications Research Service, Arlington, Va.

COST EFFECTIVENESS AND OPTIMAL PARAMETERS OF ROCKET ENGINE WITH ELECTRIC PROPULSION FOR SPACE SHUTTLE Abstract Only

D. D. Sevruk, V. K. Shinin, and A. F. Shtyrlin *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 1 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Aviatsionnaya Tekhnika (Kazan, USSR), no. 3, Jul. Sep. 1984 p 65-69 (For primary document see N87-16179 08-31)

Avail: NTIS HC A07/MF A01

N87-16753*# Tuskegee Inst., Ala. Dept. of Electrical Engineering.

INVESTIGATION OF POTENTIAL DRIVER MODULES AND TRANSMISSION LINES FOR A HIGH FREQUENCY POWER SYSTEM ON THE SPACE STATION

Harold T. Brush *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 35 p (For primary document see N87-16742 08-99)

Avail: NTIS HC A99/MF E04 CSCL 10B

N87-16760*# Georgia Univ., Athens. Dept. of Geology.

A STUDY OF THE POSSIBLE EFFECT OF A THERMAL POST CURE ON THE MECHANICAL PROPERTIES OF THE 404 CARBON-PHENOLIC RING OF THE SPACE SHUTTLE SOLID ROCKET MOTOR NOZZLE

A. A. Giardini *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 24 p (For primary document see N87-16742 08-99)

Avail: NTIS HC A99/MF E04 CSCL 21H

N87-16773*# Athens Coll., Ala. Dept. of Chemistry.

EVALUATION OF MOISTURE BARRIER COATINGS ON CARBON-PHENOLIC SRM NOZZLE MATERIALS

Ronald C. McNutt *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 19 p (For primary document see N87-16742 08-99)

Avail: NTIS HC A99/MF E04 CSCL 21H

N87-16777*# Pennsylvania Univ., Philadelphia. Dept. of Systems.

MANAGEMENT OF SSME HARDWARE LIFE UTILIZATION

J. M. Pauschke *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)

Avail: NTIS HC A99/MF E04 CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

N87-16069# Joint Publications Research Service, Arlington, Va.

JAPAN REPORT: SCIENCE AND TECHNOLOGY

30 Sep. 1986 56 p Transl. into ENGLISH from various Japanese articles

(JPRS-JST-86-029) Avail: NTIS HC A04/MF A01

Articles from various Japanese publications are translated. Under the heading of biotechnology there is an article entitled: Impact of recent deve'opments on industries described. Under the heading of new materials: Report on new materials and related developments. And under the heading of nuclear development: Facility utilization ratio for June reported. For individual titles, see N87-16070 through N87-16070.

N87-16070# Joint Publications Research Service, Arlington, Va.
REPORT ON NEW MATERIALS, RELATED DEVELOPMENTS *In its* Japan Report: Science and Technology (JPRS-JST-86-029) 30 Sep. 1986 p 37-48 Transl. into ENGLISH from Nikko Materials (Tokyo, Japan), Apr. 1986 p 23-29 (For primary document see N87-16069 08-23)
Avail: NTIS HC A04/MF A01

An article is translated from a Japanese journal on development of new materials. Mitsubishi has developed an oxygen atmosphere hot isostatic pressing unit for molding oxide ceramics. A crystalline glass called Ilmavit 40 is being imported into Japan from East Germany which can be casted and machined and can be used as a material for chemical plants. Two Japanese companies have joined together to manufacture a new electroconductive carbon called Ketjen Black. A new grinding machine which can grind high hardness fine ceramics such as silicon nitride and silicon carbide with ultrasonic waves at a speed 5 to 10 times that of conventional machines. A machinable ceramic has been developed based on aluminum nitride which has strength equivalent to that of alumina. A Japanese co. has entered the field of ceramics by establishing a new co. specializing in ceramic sales. Fatigue test time for metallic materials was reduced to 1/10. Very thin new speaker units were developed. A new co. was established to produce magnets in collaboration with a French co. Magnetic filters were developed which extracts magnetically suspended particles contained in water. E.R.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N87-16071*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PMR POLYIMIDE COMPOSITIONS FOR IMPROVED PERFORMANCE AT 371 DEG C
Raymond D. Vannucci 1987 13 p Prepared for presentation at the 32nd International SAMPE Symposium and Exhibition, Anaheim, Calif., 6-9 Apr. 1987
(NASA-TM-88942; E-3390; NAS 1.15:88942) Avail: NTIS HC A02/MF A01 CSCL 11D

Studies were conducted to identify matrix resins which have potential for use at 371 C (700 F). Utilizing PMR methodology, neat resin moldings were prepared with various monomer reactants and screened for thermo-oxidative stability at 371 C (700 F) under both ambient and a four-atmosphere air pressure. The results of the resin screening studies indicate that high molecular weight (HMW) formulated resins of first (PMR-15) and second (PMR-II) generation PMR materials exhibit lower levels of weight loss at 371 C (700 F) than PMR-15 and PMR-II resins. The resin systems which exhibited the best overall balance of processability, Tg and thermo-oxidative stability at 371 C were used to prepare unidirectional Celion 6000 and T-40R graphite fiber laminates. Laminates were evaluated for thermo-oxidative stability and 371 C mechanical properties. Results of the laminate evaluation studies indicate that two of the resin compositions have potential for use in 371 C applications. The most promising resin composition provided laminates which exhibited no drop in 371 C mechanical properties and only 11 percent weight loss after 200 hr exposure to 4 atmospheres of air at 371 C. Author

N87-16072# Naval Academy, Annapolis, Md.
ENVIRONMENTAL EFFECTS ON IMPACT DAMAGE TOLERANCE OF HYBRID COMPOSITE MATERIAL Final Report
Lawrence E. Wood 28 May 1986 56 p
(AD-A171743; USNA-TSPR-140) Avail: NTIS HC A04/MF A01 CSCL 11/4

The behavior of an intraply hybrid composite material of polyethylene and graphite fibers in an epoxy matrix under the effects of environmental conditioning, impact damage, and fatigue loading was investigated. Although the ultimate tensile strength of the hybrid material was found to be lower than that of graphite material alone, the specific strengths of the materials were comparable. Dye-penetrant enhanced X-ray radiography and edge replication were used to evaluate the damage growth of the test material. Impact damage evaluations showed the initial crack tolerance of the hybrid materials was better than that of conventional graphite. Specimens of both materials were soaked in standard ocean water and their moisture absorption observed. The moisture absorption percentages for the hybrid and graphite materials were 2.91 percent and 1.47 percent by weight respectively. Both dry and wet hybrid material was subjected to impact and fatigue loading. During fatigue loading the hybrid material exhibited viscoelastic behavior characterized by a non-linear loading curve. The wet hybrid material experienced both a sharper reduction in stiffness, and a greater increase in damage area than the dry material. GRA

N87-16073# Virginia Univ., Charlottesville. Dept. of Materials Science.
INVESTIGATION OF MICROSTRUCTURAL FACTORS THAT CAUSE LOW FRACTURE TOUGHNESS IN SILICON CARBIDE WHISKER/Al ALLOY COMPOSITES Annual Report, 1 May 1985 - 28 Feb. 1986
F. E. Wawner and C. R. Harris 15 Aug. 1986 38 p
(Contract N00014-85-K-0179)
(AD-A171796; UVA/525398/MS87/101) Avail: NTIS HC A03/MF A01 CSCL 11/6

The problem of low fracture toughness and low elongation to failure in silicon carbide whisker/aluminum alloy matrix composites is controlled by matrix composition and microstructure. Large, brittle, constituent particles as well as other precipitate phases along whisker interfaces strongly influence these properties. The purpose of this study is to define the fracture characteristics of the material from an atomic standpoint; to define the factors that influence fracture toughness and elongation; to propose a model for the failure mechanism and steps that can be taken to enhance the properties; and to evaluate materials produced by using these concepts. Work during the first year of this program has emphasized microstructural and mechanical property evaluation of systems with altered chemistry of the alloy matrix and thermomechanical treatments of standard alloy systems. GRA

N87-16074# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
ULTRASONIC CHARACTERIZATION OF MATERIAL PROPERTIES OF COMPOSITE MATERIALS
Subhendu K. Datta and H. M. Ledbetter Jul. 1986 13 p
(Contract N00014-86-K-0280)
(AD-A172112; CUMER-86-1) Avail: NTIS HC A02/MF A01 CSCL 11/4

Ultrasonic waves provide an excellent means to study the mechanical properties of both heterogeneous and composite materials. Recently, both theoretically and experimentally, we studied characteristics of elastic wave propagation through fiber and particle reinforced composites. Theoretically we analyzed phase velocities of longitudinal and shear waves propagating through composite media with aligned continuous fibers and ellipsoidal shaped particles. Alignment of reinforcing fibers (or particles) imparts anisotropy to the effective mechanical and physical properties of the composite. Theoretically, we modeled the anisotropic phase velocities, which agree with experimental measurements. One important feature of this combined theoretical and experimental study is the possibility of obtaining the

(often uncertain) fiber (or particle) elastic properties by comparing the model predictions with the observations. We show that one can use the theoretical model to obtain effective properties of media containing voids (Pores). As examples, we consider porous olivine and creep cavities in copper. In the latter case some experimental results are presented which show good agreement with predictions. Finally, we present some results for attenuation in a particulate composite including the effect of nonideal interface properties. Author (GRA)

N87-16075# Midwest Research Inst., Kansas City, Mo.
THE ROLE OF REACTIVE FUNCTIONAL GROUPS IN ADHESIVE BONDING AT THE ARAMID-EPOXY INTERFACE Final Report
L. S. Penn, T. J. Byerley, and T. K. Liao 15 Sep. 1986 8 p
(Contract N00014-84-C-0522)
(AD-A172128) Avail: NTIS HC A02/MF A01 CSCL 11/4

In polymeric composites, reactive functional groups on the fiber surface are assumed to greatly enhance the mechanical strength of the fiber-matrix interface by forming covalent bonds with the matrix. To test this assumption, we sought to promote covalent bonding at the aramid fiber-epoxy matrix interface by attaching flexible reactive pendent groups to the fiber surface. Other factors that could affect interfacial adhesion were kept constant, i.e., surface energy and surface topography. Quantitative analysis showed a pendent group attachment level of 1.5-4.5 groups per 100 square A of fiber surface, a level that agrees well with the theoretical amount. Surprisingly, in adhesive performance tests, the presence of these reactive pendent groups did not improve the fiber-matrix interface strength. Specific chemical tests for covalent bond formation between the terminal amine of the pendent group and the epoxy molecule showed that covalent bonding did not occur, thus explaining the unexpected lack of improvement in adhesive performance. GRA

N87-16076# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
INTERFACE EFFECTS ON ATTENUATION AND PHASE VELOCITIES IN COMPOSITES
S. K. Datta, H. M. Ledbetter, Y. Shindo, and S. H. Shah Aug. 1986 12 p
(Contract N00014-86-K-0280)
(AD-A172134; CUMER-86-3) Avail: NTIS HC A02/MF A01 CSCL 20/11

Much current practical interest exists concerning wave propagation through a composite medium with a random distribution of inclusions: particles, flakes, long continuous or chopped fibers in a homogeneous matrix. Several theoretical studies report wave speeds and attenuation of coherent plane waves propagating through an elastic homogeneous medium containing reinforcing particles or fibers. All theses studies assume that the interface between the matrix and the inclusion is sharply defined. Also, it is mostly assumed that the inclusion is perfectly bonded to the matrix. The present study analyzes the problem of damping in metal-matrix composites when there is an interface layer through which the inclusion property changes continuously to that of the matrix. GRA

N87-16077# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
FIBER-MATRIX INTERACTIONS IN CARBON-FIBER/CEMENT MATRIX COMPOSITES
David C. Cranmer and Dana J. Speece 25 Jul. 1986 22 p
(Contract F04701-85-C-0086)
(AD-A172751; TR-0086(6935-14)-1; SD-TR-86-48) Avail: NTIS HC A02/MF A01 CSCL 11/4

An understanding of the nature of the interface between fiber and composite matrix is essential for development of ceramic-matrix and metal-matrix composites. It has been shown that the use of organometallic-based coatings on carbon fibers aids processing and improves properties in metal-matrix composites. The present report deals with the use of similarly coated carbon fibers in various cement matrices. It describes the method of applying the coatings and the differences in the fiber-matrix interfacial region due to the use of different coatings. The tensile properties are discussed and related to the differences seen at the interface as well as to differences in processability. GRA

N87-16078# Massachusetts Inst. of Tech., Cambridge. Technology Lab. for Advanced Composites.
DYNAMICS AND AEROELASTICITY OF COMPOSITE STRUCTURES Final Report, 1 May 1984 - 30 Jun. 1985
John Dugundji and Gun-Shing Chen 1 Mar. 1986 30 p
(Grant AF-AFOSR-0142-84)
(AD-A172922; TELAC-85-25; AFOSR-86-0892TR) Avail: NTIS HC A03/MF A01 CSCL 01/3

An analytical and experimental investigation was made of the aeroelastic flutter and divergence behavior of graphite/epoxy forward swept wings with rigid body pitch and plunge freedoms present. A complete, two-sided 30-degree forward swept wing aircraft model was constructed and mounted with low friction bearing in a low speed wind tunnel. Four different ply layup wings could be interchanged on the model. Wind tunnel tests on the free flying models revealed body freedom flutter, bending torsion flutter, and a support dynamic instability which could be eliminated by proper adjustment of the support stiffness. Good agreement with linear theory was found for the observed instabilities. GRA

N87-16079# Aeronautical Research Labs., Melbourne (Australia).
DYNAMIC RESPONSE OF A GRAPHITE/EPOXY COMPOSITE PLATE
M. Heller and S. J. Rumble May 1986 29 p
(AD-A173718; ARL-STRUC-TM-438) Avail: NTIS HC A03/MF A01 CSCL 11/4

Graphite/epoxy composites have many advantages as aircraft structural materials and for this reason their use is becoming increasingly widespread. However, graphite/epoxy composites are susceptible to a wide range of damage. In particular, impact can cause a significant amount of delamination, even though the only external indication of damage may be a very small surface indentation. For this reason, this type of damage is often referred to as barely visible impact damage (BVID). The development of improved and more efficient means of detecting such damage is important. This paper investigates the potential for characterizing the dynamic response of a graphite/epoxy composite plate to indicate the presence and possibly the location of BVID. A brief outline of vibrational analysis is given in section 2. The investigations included single point accelerometer response, time-averaged holographic interferometry and thermoelastic analysis. It was found that the detection of BVID using vibration analysis is complicated by the sensitivity of the analysis to boundary conditions and the means of excitation. Further investigation would require larger specimens to reduce the effects of boundary conditions. GRA

N87-16080# Rockwell International Science Center, Thousand Oaks, Calif.
FIBER MATRIX INTERFACE EFFECTS IN FAILURE OF CERAMIC MATRIX FIBER COMPOSITES Annual Report, 15 Jul. 1985 - 14 Jul. 1986
D. Marshall, B. N. Cox, W. C. Oliver, and A. G. Evans Oct. 1986 123 p
(Contract N00014-85-C-0416)
(AD-A174146; SC5432.AR) Avail: NTIS HC A06/MF A01 CSCL 11/4

Mechanical behavior of ceramic fiber composites has been investigated. Methods were developed for measuring mechanical properties of the fiber/matrix interface at individual fibers, and micromechanics models were developed to analyze debonding and sliding at the interface. A fracture mechanics model for tensile failure of composites has been developed. Solutions from this model define several different failure mechanisms and provide relations between strength, toughness and conditions for transition in failure mechanism in terms of microstructural properties of the composite. GRA

N87-16081# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EFFECTS OF CURE AND SIZING ON FIBER-MATRIX BOND

STRENGTH Interim Report, Sep. 1984 - Apr. 1986
Piet W. Peters and George S. Springer Sep. 1986 31 p
(Contract F33615-84-C-5049)
(AD-A174160; AFWAL-TR-86-4054) Avail: NTIS HC A03/MF A01 CSCL 11/4

Experiments were performed to evaluate the effects of cure and sizing on the bond strength between graphite fiber bundles and epoxy resins. Fiberite 976 and 934 resins and Thornel T300 (3K) fibers were used in the tests. The fibers were either uncoated (no sizing) or coated with different types of sizing. Pure resin specimens containing a single coated or uncoated fiber bundle were prepared by curing in a mold at different temperatures. The specimens were subjected to three point bending, and the load versus deflection curves were recorded. Photomicrographs of fiber bundles embedded in the resin were also taken. The data show the influence of the cure temperature (and the corresponding degree of cure) on the fracture strain and on the stiffness of the pure resins. The data also indicate the effects of cure temperature and sizing on the fiber bundle-resin bond strength (as manifested by the specimen's fracture strain), and the effect of sizing on the geometry of the bundle and on the fiber density inside the bundle. GRA

N87-16082# Sandia National Labs., Albuquerque, N. Mex.
DAMAGE CHARACTERIZATION AND RESIDUAL PROPERTIES OF A SHOCK-LOADED S-2 GLASS/EPOXY LAMINATE
T. R. Guess and E. D. Reedy, Jr. 1986 18 p Presented at the 18th Society for the Advancement of Materials and Process Engineering National Technical Conference on Materials, Seattle, Wash., 7 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-011179; SAND-86-1233C; CONF-861004-1) Avail: NTIS HC A02/MF A01

Gas gun planar impact and post-impact three-point-bend test data are presented for [90 sub 4,(+24,-24) sub 2,90 sub 3 (-24,+24) sub 2 90 sub 4] S-2 glass/epoxy laminates. Laminates with 2 different densities (Porosities) were tested. The impact tests, which utilized standard gas gun spall test techniques, were designed to generate tensile wave damage in a plane parallel to the laminate surface and midway through its thickness. Polished sections taken from impacted high porosity samples indicate that incipient shock damage is generated at a stress level of between 1 and 2 kbar for a nominal 1 ms stress pulse. The incipient stress wave damage consists of matrix cracking in the center 90 deg layer. Limited test data did not permit establishment of a damage threshold for the low porosity laminate. Large separations, extending over the sample's entire diameter, were generated in samples of both porosity when the impact stress level was greater than or equal to 3 kbar. These samples were not, however, cleaved in two; fiber bridging prevented complete detachment. Post-impact three-point-bend test data indicate that once a threshold impact stress level for damage is exceeded, both specimen stiffness and load carrying capacity decrease substantially as the impact stress level increases. For example, specimen stiffness and load carrying capacity of the low porosity composite were reduced by 75% and 50%, respectively, after impact at a 6.35 kbar stress level. DOE

N87-16015*# Ametek, Inc., Anaheim, Calif. Composite Materials and Applications Div.
ADVANCED COMPOSITES FOR LARGE NAVY SPACECRAFT
William E. Davis *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 1-10 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 11D

N87-16174# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL MODEL OF A FIBER-STRUCTURE COMPOSITE MATERIAL
R. P. Mainya, I. N. Preobrazhenskiy, P. I. Preobrazhenskiy, and G. N. Khashba *In its* USSR Report: Engineering and Equipment 13 Aug. 1986 p 62 Transl. into ENGLISH from Soobshcheniya Akademii Nauk Gruzinskoy SSR (Tbilisi, USSR), v. 120, no. 3, 1985 p 501-504 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

N87-16349# Tel-Aviv Univ. (Israel). Center for Technological Education.
WAVE PROPAGATION IN RANDOM COMPOSITE MATERIALS
A. I. Beltzer *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 7 Jul. 1986 p 11-15 (For primary document see N87-16347 08-39)
Avail: NTIS HC A04/MF A01

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N87-16083 ESDU International Ltd., London (England).
THERMAL CONDUCTIVITY OF LIQUID MIXTURES
Dec. 1986 27 p
(ESDU-86039; ISBN-0-85679-591-7; ISSN-0141-4062; ISSN-0141-4070) Avail: ESDU

This Data Item ESDU 86039 is an addition to the Physical Data, Chemical Engineering Sub-series. A simple rule is given for predicting the thermal conductivity of binary and multicomponent mixtures from a knowledge of the thermal conductivity of the pure components. The rule is found to be an improvement on the simple addition of contributions according to weight fraction. A bibliography of sources of experimental measurements on liquid mixtures is included, and for binary mixtures is indexed by the name of each pure component, for ease for reference. ESDU

N87-16084*# Eloret Corp., Sunnyvale, Calif.
THEORETICAL RESEARCH PROGRAM TO STUDY TRANSITION METAL TRIMERS AND EMBEDDED CLUSTERS Semiannual Report, 1 Jul. - 31 Dec. 1986
Stephen P. Walch 31 Dec. 1986 80 p
(Contract NCC2-296)
(NASA-CR-180138; NAS 1.26:180138) Avail: NTIS HC A05/MF A01 CSCL 07D

The calculation of potential energy surfaces for chemical reactions was the focus of investigation. Two groups of reactions were considered: the subset of reactions important in H2 combustion, and high temperature air chemistry reactions (O + N yields NO + N and N + O2 yields NO + O). For individual titles, see N87-16085 through N87-16086.

N87-16085*# Eloret Corp., Sunnyvale, Calif.
EXTENDED ACTIVE SPACE CASSCF/MRSD CI CALCULATIONS OF THE BARRIER HEIGHT FOR THE REACTION: O + H2 YIELDS OH + H
Stephen P. Walch *In its* Theoretical Research Program to Study Transition Metal Trimers and Embedded Clusters 31 Dec. 1986 23 p (For primary document see N87-16084 08-25)
Avail: NTIS HC A05/MF A01 CSCL 07D

The convergence of the barrier height for the O + H2 yields OH + H reaction was studied as a function of the size of the active space and basis set completeness. The barrier height is rapidly convergent with respect to expansion of the active space. Addition of 2p yields 2p' correlation terms to the active space lowers the barrier to the O + H2 reaction by about 2.0 kcal/mole, but addition of 3d and other terms has little additional effect. Multireference singles and doubles contracted CI plus Davidson's correction calculations using a (5s5p3d2f1g/4s3p2d1f) basis set with a 5 sigma 2 pi active space lead to a barrier height of 12.7 kcal/mole. Including an estimate of the CI contraction error and basis set superposition error leads to 12.4 kcal/mole as the best estimate of the barrier height. Author

N87-16085*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATED POTENTIAL SURFACES FOR THE REACTIONS: O + N2 YIELDS NO + N AND N + O2 YIELDS NO + O
Stephen P. Walch and Richard J. Jaffe *In* Eloret Corp. Theoretical Research Program to Study Transition Metal Trimers and Embedded Clusters 31 Dec. 1986 51 p Prepared in cooperation with Eloret Corp., Sunnyvale, Calif. (For primary document see N87-16084 08-25)
Avail: NTIS HC A05/MF A01 CSCL 07D

Complete Active Space SCF/Contracted CI (CASSCF/CCI) calculations, using large Gaussian basis sets, are presented for selected portions of the potential surfaces for the reactions in the Zeldovich mechanism for the conversion of N2 to NO. The N + O2 reaction is exoergic by 32 kcal/mole and is computed to have an early barrier of 10.2 kcal/mole for the (sup 2)A(sup prime) surface and 18.0 kcal/mole for the (sup 4)A(sup prime) surface. The O + N2 reaction is endoergic by 75 kcal/mole. The (sup 3)A(sup double prime) surface is calculated to have a late barrier of 0.5 kcal/mole, while the (sup 3)A(sup prime) surface is calculated to have a late barrier of 14.4 kcal/mole. Author

N87-16087*# Houston Univ., Tex. Dept. of Mechanical Engineering.
NUMERICAL SIMULATION OF ELECTROPHORESIS SEPARATION PROCESSES Interim Report
D. K. Ganjoo and T. E. Tezduyar 22 Dec. 1986 104 p
(Contract NAS9-17380)
(NASA-CR-180124; NAS 1.26:180124) Avail: NTIS HC A06/MF A01 CSCL 07D

A new Petrov-Galerkin finite element formulation has been proposed for transient convection-diffusion problems. Most Petrov-Galerkin formulations take into account the spatial discretization, and the weighting functions so developed give satisfactory solutions for steady state problems. Though these schemes can be used for transient problems, there is scope for improvement. The schemes proposed here, which consider temporal as well as spatial discretization, provide improved solutions. Electrophoresis, which involves the motion of charged entities under the influence of an applied electric field, is governed by equations similiar to those encountered in fluid flow problems, i.e., transient convection-diffusion equations. Test problems are solved in electrophoresis and fluid flow. The results obtained are satisfactory. It is also expected that these schemes, suitably adapted, will improve the numerical solutions of the compressible Euler and the Navier-Stokes equations. Author

N87-16088# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
THE SPECTROSCOPY AND REACTION KINETICS OF TRANSIENT SPECIES Final Report, 1 Jan. - 31 Dec. 1985
Eric Weitz 4 Jun. 1986 9 p
(Grant AF-AFOSR-0099-85)
(AD-A171904; AFOSR-86-0557TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

A diode laser system has been acquired through the DOD-University Research Program. This diode laser system will be employed in an apparatus which will be used for studying transient gas phase species via IR spectroscopy. The apparatus has a time response of 35 nsec and a sensitivity of 10 to the 10th power molecules/cc. The apparatus is capable of providing information on the structure, rates of reaction and rates of relaxation of transient species. It is currently being used to study reactions of vinyl radicals and energy disposition in CO's photoejected from metal carbonyl molecules. GRA

N87-16089# Colorado State Univ., Fort Collins. Dept. of Chemistry.
SUPERSONIC MOLECULAR JET STUDIES OF THE PYRAZINE AND PYRIMIDINE DIMERS
J. Wanna, J. A. Menapace, and E. R. Bernstein 1 Jun. 1986 38 p
(Contract N00014-79-C-0647)
(AD-A172049; TR-20) Avail: NTIS HC A03/MF A01 CSCL 07/4

Mass selected optical spectra for the first excited singlet pi states of the pyrazine and pyrimidine dimers are presented. The species are created in a pulsed supersonic jet expansion. The spectra are analyzed based on ionization energy, vibronic structure and relative energy with respect to the isolated monomer (cluster spectroscopic shift). Calculations of binding energy and geometry for these dimers are carried out employing a lennard-jones (6-12-1) and hydrogen bonding (10-12-1) potential. In the case of pyrazine, calculations and experiments agree that both parallel planar hydrogen bonded and perpendicular dimers are present in the expansion. The calculations also predict a parallel stacked and 90 deg. rotated pyrazine dimer which is not observed. This latter species most likely forms an excimer in the excited state with a short lifetime and a highly red shifted broad spectrum. In the case of pyrimidine, calculations yield four planar hydrogen bonded species and a parallel stacked and displaced species. The spectra for the pyrimidine dimer are consistent with these configurations, in agreement with the calculations. No perpendicular configuration is calculated for the pyrimidine dimer and no spectroscopic features require postulating the existence of such a configuration. To explore further the agreement between calculated and experimental results for aromatic dimers, calculations are also presented for the tetrazine dimer. GRA

N87-16090# Texas Univ., Austin. Dept. of Physics.
HIGH RESOLUTION ELECTRON ENERGY LOSS STUDIES OF CHEMISORBED SPECIES ON ALUMINUM AND TITANIUM Final Report, 1 Apr. 1983 - 31 Mar. 1986
J. L. Erskine 12 Apr. 1986 14 p
(Grant AF-AFOSR-0131-83)
(AD-A172055; AFOSR-86-0750TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

This project utilized high resolution electron energy loss spectroscopy to investigate chemical processes at metal surfaces. The research during the grant period being reported has been highly successful in: (1) advancing the state of the art in instrumentation, (2) developing lattice dynamical techniques for calculating the vibrational properties of surfaces and demonstrating the application of these techniques to structure determination, (3) exploring the application of vibrational spectroscopy to novel underlayer formation occurring as a consequence of chemisorption at Al and Ti surfaces, and (4) examining some of the fundamental issues related to scattering mechanisms and selection rules that govern them. Our experiments have also uncovered an interesting relationship between the surface vibrational properties and the order-disorder phase transformation of W(100). GRA

N87-16091# Air Force Academy, Colo.
MOPAC MANUAL (VERSION 3.10) A GENERAL MOLECULAR ORBITAL PACKAGE: CRAY-XMP VERSION
James J. Stewart Jun. 1986 150 p
(AD-A172100; FJSRL-TR-86-0008) Avail: NTIS HC A07/MF A01 CSCL 07/4

MOPAC is a general-purpose, semi-empirical molecular orbital program for the study of chemical reactions involving molecules, ions, and linear polymers. It implements the semi-empirical Hamiltonians MNDO, AM1 and MINDO/3 and combines the calculations of vibrational spectra, thermodynamic quantities, isotopic substitution effects, and force constants in a fully integrated program. Elements parametrized at the MNDO level include H, Li, Be, B, C, N, O, F, Al, Si, P, S, C1, Cr, Ge, Br, Sn, Hg, Pb, and I. Within the electronic part of the calculation, molecular and localized orbitals excited states up to sextets, chemical bond indices, charges, etc. are computed. Both intrinsic and dynamic reaction coordinates can be calculated. A transition-state location routine and two transition-state optimizing routines are available for studying chemical reactions. GRA

N87-16092# SRI International Corp., Menlo Park, Calif.
SURFACE GENERATION OF ELECTRONICALLY EXCITED STATES OF O2 Final Scientific Report
Tom G. Slanger 9 Jul. 1986 71 p

(Contract F49620-82-K-0025)
(AD-A172426; SRI-MP-86-130; AFOSR-86-0849TR) Avail: NTIS HC A04/MF A01 CSCL 07/4

This investigation of surface-related processes consisted of two parts; laboratory studies of the production and loss of electronically excited oxygen species on metallic surfaces, and an investigation of the mechanisms that might contribute to the so-called Space Shuttle glow. In the laboratory work, production by atom recombination of the states of O2 that lie between 4 and 5 eV was studied. The efficiency of their generation was correlated with the identity of the metal, its position on the periodic chart, surface temperatures, alloy composition, and the electronic heat capacity. Spectra of the emissions originating at the surfaces were shown to be non-specific to the particular metal, implying that internal energy distributions in the emitting metastable molecules were determined by gas phase interactions. Further study of surface energy accommodation, and the possible generation of highly vibrationally excited molecules is called for. The loss of O2 on metallic surfaces was investigated, and showed both similarities and differences with the production of the higher O2 states on the same surfaces. Metals in a given group of the periodic chart tend to exhibit similar temperature effects. The Space Shuttle glow study involved development of a model for the process, which has been useful in guiding the investigations as subsequent in situ experiments have been carried out. By consideration of the present status of the observations, it has been found possible to clarify which of the current explanations of the glow forming mechanisms are viable, and which must be discarded. GRA

N87-16093# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
FUELS COMBUSTION RESEARCH Final Report, 1 Mar. 1982 - 30 Sep. 1985
Frederick L. Dryer, Irvin Glassman, and Forman A. Williams 9 Dec. 1985 42 p
(Contract F49620-82-K-0011)
(AD-A172429; MAE-1731; AFOSR-86-0841TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

The qualitative mechanisms for the oxidation of benzene and alkylated benzenes corresponds well with flow reactor results. Major results have been obtained on how the aromatic sidechain reacts and specific fundamental reaction rate data have been obtained. A fundamental correlation with respect to fuel C-C bonds for the sooting tendency of fuels under premixed combustion conditions has been developed and the concept that fuel structure plays no direct role in determining the critical sooting equivalence ratio was put forth and substantiated by results on pure fuels and fuel mixtures. Fuel structure and pyrolysis mechanisms have been found to be the important controlling factors in sooting diffusion flames. From a knowledge of basic pyrolysis studies, it is now possible to predict a fuel's reveal no synergistic trends with diffusion flame sooting trends; however, these trends may be due to the structural aspects of these flames. Experimental and theoretical research efforts on high-energy-density slurry propellants are reported. Transient internal heat conduction and liquid surface regression of a rigid slurry droplet during liquid vaporization and combustion have been investigated using singular perturbation methods. Experimentally, a technique to produce isolated slurry fuel droplets of boron and JP-10 has been developed, and observations on the isolated droplet combustion characteristics of several commercially prepared boron/JP-10 slurries were made. GRA

N87-16094# Purdue Univ., West Lafayette, Ind. Thermal Sciences and Propulsion Center.
FUEL SPRAY IGNITION BY HOT SURFACES AND AIRCRAFT FIRE STABILIZATION Final Report, 15 Nov. 1981 - 31 Mar. 1986
J. G. Skifstad, A. H. Lefebvre, and S. N. Murthy 1 Jun. 1986 33 p
(Grant AF-AFOSR-0107-82)
(AD-A172827; LMS/AFOSR-COMB/83; AFOSR-86-0856TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

In Task 1 an experimental study of the ignition of Jet-A fuel sprays by an isothermal hot surface was conducted in a vertical axisymmetric duct. In addition to measurements of the wall temperature necessary for ignition, local measurements of velocity, turbulence intensity, fuel concentration, and the fraction of fuel vaporized were measured in the boundary layer at surface temperatures just below that required for ignition. In Task 2 two combustion tunnel facilities were used to investigate the stabilization of aircraft fires. Results showed that the shape of a bluff-body flameholder affects its stability characteristics through its influence on the size and shape of the wake region. Another significant finding was that the flameholding properties of the single-vortex flow pattern are markedly superior to those of the double-vortex pattern. In Task 3 experimental studies were conducted on: (1) Entrainment of an external flow into a cavity, with a small opening or vent in a side wall, when there is a small flow through the cavity; and (2) Fluid dynamics and ignition and flame stability characteristics of a jet of gaseous fuel through a protrusion of different shapes and heights in the wall of a cavity with a small flow of air through the cavity. GRA

N87-16095# National Bureau of Standards, Gaithersburg, Md. Chemical Kinetics Div.
THERMAL STABILITY CHARACTERISTICS OF NITROAROMATIC COMPOUNDS Final Report, 1 Jun. 1983 - 30 Aug. 1986
Wing Tsang 15 Sep. 1986 41 p
(Contract MIPR-114-86)
(AD-A172860; ARO-20116.4-CH) Avail: NTIS HC A03/MF A01 CSCL 07/4

A single pulse shock tube has been used to determine the rates and mechanisms of the initial processes during the decomposition of a number of nitroaromatic compounds at temperatures near 1100 K. For nitrobenzene and p-nitrotoluene, the primary decomposition pathways involve the breaking of the C-NO2 bond and the isomerization of the NO2 group to form the nitrite, followed by rapid cleavage of the weak CO-NO bond. In the case of o-nitrotoluene, although these channels also make contributions, the principal pyrolytic mechanism involve an intermolecular rearrangement leading to the formation and rapid decomposition of anthranil. This represents the first report of such a process occurring purely in the gas phase and thus without the aid of acid, base or photon catalysis. It is clear that the presence of a methyl ortho to the nitro group in nitroaromatic compounds introduces a new element into the decomposition behavior of such compounds. Inasmuch as these are low activation energy processes, we expect that such reactions will be of even more importance in the lower temperature regions where ignition behavior is intimately related to the chemical kinetics. We describe in detail the unique features of single pulse shock tube experiments and the systematic studies which permit unambiguous determination of the reaction mechanisms and the elucidation of high accuracy rate constants and expressions. GRA

N87-16096# Naval Research Lab., Washington, D. C.
NUMERICAL STUDY OF FLOW TURNING PHENOMENON
Joseph D. Baum 10 Oct. 1986 45 p
(AD-A172868; NRL-MR-5868) Avail: NTIS HC A03/MF A01 CSCL 21/2

The objective of the present research work is an understanding of the physical mechanisms by which energy is exchanged between the mean and acoustic flow fields in resonant combustion chambers (in particular, solid rocket motors). These processes may alter the balance between sources and sinks of oscillatory energy in the combustor significantly and thus are critical to our ability to predict the stability characteristics of proposed motor designs. The present report concentrates on the description and analysis of the computational results obtained to date in the study of acoustic refraction and flow turning phenomena. Three studies were conducted. The time-dependent compressible Navier Stokes equations were solved utilizing an implicit, non-iterative Linearized Block Implicit scheme. In the first study acoustic wave propagation in a tube with a coexisting sheared mean flow was investigated. The results demonstrate that acoustic refraction effects, i.e., the

growth of acoustic pressure near the wall (for downstream propagation), are significant., In addition, the results demonstrate acoustic energy transfer to the mean flow as well as Richardson's annular effect. To the best of the authors' knowledge these are the first solutions demonstrating either Richardson's annular effect or refraction effects that are obtained through solution of the complete Navier-Stokes equations. GRA

N87-16097# Massachusetts Inst. of Tech., Cambridge.
BASIC INSTABILITY MECHANISMS IN CHEMICALLY REACTING SUBSONIC AND SUPERSONIC FLOWS Annual Report, 30 Sep. 1984 - 29 Sep. 1985
Tau-Yi Toong 21 Oct. 1985 28 p
(Grant AF-AFOSR-0373-83)
(AD-A172904; AFOSR-86-0887TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

Both theoretical and experimental studies were conducted to determine and elucidate major mechanisms governing turbulence-combustion interactions. The theoretical study showed the importance of wrinkling-like effects as well as the effects of the chemical reaction rate on the evolution of fluctuations in streamwise- and transverse-velocity, temperature, concentration, and vorticity in a shear layer. The wrinkling-like effects were induced by the transverse-velocity fluctuations in nonuniform mean flows. The direct rate-augmentation effects due to reaction led to changes in phase relationships between the various fluctuations, resulting in turbulent energy and mass transport in a direction opposite to that suggested by the gradient model in that part of the shear layer nearer the unreacted region. The experimental study showed the effects of adding ethane (at the same overall equivalence ratio) on the thermal structure of methane/air flames. Temperature fluctuations were augmented by ethane addition, the highest augmentation being observed at 10%-ethane addition. A one-component Laser Doppler Velocimetry system was installed and tested. GRA

N87-16098# SRI International Corp., Menlo Park, Calif.
MECHANISMS OF CO2 REDUCTION ON METAL AND MODIFIED SEMICONDUCTOR ELECTRODES Annual Report, 1 Jan. - 1 Oct. 1986
K. W. Frese, Jr. and D. P. Summers 21 Oct. 1986 8 p
(Contract N00014-86-C-0121)
(AD-A173695) Avail: NTIS HC A02/MF A01 CSCL 07/4

The goal of this project is to elucidate the mechanism of the electrochemical reduction of CO2 to methanol. A number of materials have been identified that form methanol in an electrochemical cell. These are GaAs, InP, Mo, W, and Ru. These electrode materials are used to determine the reaction mechanism. It has been shown that chemical steps limit the rate of CO2 reduction on GaAs, and therefore, the extent of surface chemical reactions and their role in the formation of methanol are of great interest. We are using a two-fold approach to mechanistic determination. First, elementary steps in the mechanism are postulated and then the thermodynamics of these steps is evaluated. The calculations allows us to: (1) reject steps with unfavorable energetics, (2) aid in the calculation of rates of feasible steps, and (3) obtain a global view of the probability of certain steps on a wide variety of materials. The experimental phase of this study includes electrochemical kinetic measurements on the CO2 reduction reaction. Essential data to be acquired include rates of product formation and faradaic efficiencies as a function of electrode potential, and pH. In addition, we are attemptind to observe surface-bound reaction intermediates. Computer data acquisition and manipulation of fast voltage transient data and FTIR are being employed. Identification of intermediates will suggest a rate limiting step and the results will be compared with model calculations. GRA

N87-16099# Kentucky Univ., Lexington.
MODELING OF EQUILIBRIUM GAS ADSORPTION FOR MULTI-COMPONENT VAPOR MIXTURES, PART 2 Contractor Report, Aug. 1984 - Aug. 1985
P. J. Reucroft, H. K. Patel, W. C. Russell, and W. M. Kim Oct. 1986 56 p
(Contract DAAK11-82-K-0016)
(AD-A174058; CRDEC-CR-87015) Avail: NTIS HC A04/MF A01 CSCL 07/4

Experimental mixed vapor adsorption data on BPL-activated carbon have been obtained for several binary organic vapor mixtures and compared with the predictions of a number of multicomponent adsorption models. Mixtures include CHCl3/CCl4, C6H14, CHCl3/CHCl2 and C6H14/CH2Cl2. Experimental techniques include an equilibrium gravimetric method and a kinetic technique which involves a study of vapor breakthrough through carbon beds. The kinetic technique yields higher values for the adsorption capacity as the polarity of the mixture increases. GRA

N87-16100# Rochester Univ., N. Y. Dept. of Chemistry.
ELECTROCHEMICAL APPROACHES TO THE REDUCTION OF CARBON DIOXIDE
Catherine OConnell, Sven I. Hommeltoft, and Richard Eisenberg 30 Oct. 1986 14 p
(Contract N00014-83-K-0154)
(AD-A174108; TR-12) Avail: NTIS HC A02/MF A01 CSCL 07/4

Carbon dioxide reduction requires the input of energy or a high energy reductant to drive the reaction. Two possible energy sources which can be used in this capacity are electro-chemical potential and light. Approaches of CO2 reduction by direct and indirect electrochemical methods are reviewed and analyzed. The indirect reductions involve the use of metal complexes in solution or on the electrode surface as electron transfer mediators and catalysts for reduction. The product distributions are sensitive to reaction media and conditions, but in many cases inadequate analyses are reported. A brief discussion of photochemical and photoelectrochemical reductions of CO2 is also given. GRA

N87-16101# Georgia Univ., Athens. Dept. of Chemistry.
SEMI-METAL CLUSTERS: LASER VAPORIZATION AND PHOTOIONIZATION OF ANTIMONY AND BISMUTH
R. G. Wheeler, K. LaiHing, W. L. Wilson, and M. A. Duncan 5 Nov. 1986 17 p
(Contract N00014-84-K-0365)
(AD-A174514; TR-29) Avail: NTIS HC A02/MF A01 CSCL 07/4

Gas phase metal clusters of antimony, bismuth, or antimony bismuth alloys are prepared by laser vaporization and probed with UV laser photoionization in a time-of-flight mass spectrometer. Unusual size distributions are observed, ending at five atom clusters. Fragmentation processes are extremely efficient at 193 nm for tetramer species regardless of elemental composition. Striking similarities in cluster stability and fragmentation patterns in these systems suggest that bonding is dominated by contributions from valence s and p electrons. GRA

N87-16102# Stanford Univ., Calif. Dept. of Mechanical Engineering.
AN INVESTIGATION OF FLOW STRUCTURE, MIXING AND CHEMICAL REACTION IN COMBUSTING TURBULENT FLOWS Annual Technical Report, 1 Sep. 1985 - 31 Aug. 1986
Craig T. Bowman and Brian J. Cantwell 1 Oct. 1986 11 p
(Grant AF-AFOSR-0373-84)
(AD-A174515; AFOSR-86-1033TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

The principal objective of this experimental investigation of the relationship between flow structure and chemical reaction in turbulent reacting flows is to examine the spatial structure of the unsteady reaction process as it relates to the unsteady velocity field. The configuration studied is a coflowing, non-premixed jet flame. A small perturbation in the fuel jet velocity, produced acoustically, is used to create a very periodic and controllable flame, suitable for conditional sampling. Initial measurements of the unsteady velocity field in the flame have been obtained using laser anemometry. In addition, flow visualization experiments have been conducted using direct and schlieren photography and Mie scattering from seed particles introduced into the flow. Planar laser-induced fluorescence images of the OH radical, which provide spatially and temporally resolved information on the instantaneous

location of the reaction zone, have been obtained. A particle tracking technique to facilitate acquisition of velocity field data is being developed. GRA

N87-16103# Massachusetts Inst. of Tech., Cambridge.
BASIC INSTABILITY MECHANISMS IN CHEMICALLY REACTING SUBSONIC AND SUPERSONIC FLOWS Annual Report, 30 Sep. 1985 - 29 Sep. 1986
Tau-Yi Toong 22 Oct. 1986 21 p
(Grant AF-AFOSR-0373-83)
(AD-A174520; AFOSR-86-2071TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

Simultaneous measurements of velocity (in a direction normal to the flame brush) and temperature in premixed, rod-stabilized, lean methane/air V-flames demonstrated the presence of high-frequency fluctuations within slowly drifting flame brushes, thus indicating a structure different from that of a simple wrinkled-laminar flame. Both the velocity and the temperature fluctuations gave maximum RMS values at a position somewhere between the unreacted and the product gases. Furthermore, cross-correlation coefficients of these simultaneous signals assumed rather high values within the reaction zone, suggesting the possibility that these fluctuation might be induced by the same governing mechanism (which, according to the theory reported previously, was due to the coupling between chemical kinetics and turbulence). A paper on the genesis of transverse waves in gaseous detonations was published in Combustion and Flame. A manuscript on the thermal structure of turbulent flames was submitted for presentation at the Fall Technical Meeting of the Eastern Section of the Combustion Institute. Another manuscript on turbulence-combustion interactions is in preparation. GRA

N87-16104# Tennessee Univ., Knoxville. Dept. of Physics and Astronomy.
VACUUM ULTRAVIOLET ELECTRONIC PROPERTIES OF LIQUIDS, EIGHTEEN YEAR PROGRESS REPORT Progress Report, 1 Nov. 1968 - 31 Jan. 1987
L. R. Painter Jul. 1986 33 p
(Contract DE-FG05-86ER-60415)
(DE86-014677; DOE/ER-60415/2) Avail: NTIS HC A03/MF A01

The principal aim of this program has been to study the electronic structure of liquids over a broad energy range, 2 to 25 eV. These studies basically consist of measuring the reflectance, transmittance, photoionization and photoemission of liquids in the vacuum ultraviolet spectral region as a function of angle of incidence and photon energy. Such measurements are analyzed to yield the optical and dielectric functions of the liquid as functions of photon energy. These functions describe electron motion in liquids as stimulated by nuclear radiation, visible and ultraviolet light, and charged particles. A knowledge of the interactions of radiation with molecular liquids has direct biological application in terms of understanding radiation damage to living material, to radiotherapy, to radiation dosimetry, to problems in cell biology, and to calculation of the actual degree of adhesive interactions between biological cells and between cells and artificial matter. Applications are made to radiation chemistry, upper atmospheric physics, and aerosol formation. DOE

N87-16105# Kentucky Univ., Lexington. Dept. of Physics and Astronomy.
PHYSICAL AND CHEMICAL PROPERTIES OF GRAPHITE INTERCALATION COMPOUNDS Progress Report, 1 Aug. 1985 - 31 Oct. 1986
P. C. Eklund 20 Jul. 1986 12 p
(Contract DE-FG05-84ER-45151)
(DE86-014684; DOE/ER-45151/2) Avail: NTIS HC A02/MF A01

Research on the following is summarized: c-axis electrical properties of acceptor-type graphite intercalation compounds (GICS), resonant Raman scattering in metals, charge transfer and the electrical and lattice dynamical properties of GICS, and hydrogen chemisorption and physisorption in alkali metal GICS. DOE

N87-16106# Council for Mineral Technology, Randburg (South Africa). Analytical Science Div.
COMPUTER PROGRAMME FOR USE IN THE DEVELOPMENT OF MULTI-ELEMENT X-RAY-FLUORESCENCE METHODS OF ANALYSIS
G. J. Wall 30 Oct. 1985 12 p Prepared in cooperation with Council for Mineral Technology, Randburg (South Africa)
(DE86-703328; MINTEK-M-214) Avail: NTIS (US Sales Only) HC A02/MF A01

A computer program (written in BASIC) is described for the evaluation of spectral-line intensities in X-ray fluorescence spectrometry. The program is designed to assist the analyst while he is developing new analytical methods, because it facilitates the selection of the following evaluation parameters: calculation models, spectral-line correction factors, calibration curves, calibration ranges, and point deletions. In addition, the program enables the analyst to undertake routine calculations of data from multielement analyses in which variable data-reduction parameters are used for each element. DOE

N87-16107# Ames Lab., Iowa.
BIBLIOGRAPHY OF LASER MASS SPECTROMETRY FOR CHARACTERIZATION OF SYNTHETIC AND NATURAL SOLIDS
R. J. Conzemius and G. A. Junk Jan. 1986 150 p
(Contract W-7405-eng-82)
(DE87-001005; DOE/NBM-7001005; IS-4892) Avail: NTIS HC A07/MF A01

This bibliography has 1461 references listed in alphabetical order according to the first author. Each reference has been coded into eight major subject categories and 105 minor subject categories. A cross index of these subjects is listed. The major subjects, with the number of references listed for each subject in parenthesis, are as follows: Analytical Features (228); Applications (1412); General Articles (244); Instrumentation (635); Laser Parameters (209); Laser Solid Interactions (805); Mass Spectra (704); and Specific Instruments (244). An author frequency index is also listed as an indicator of the activity of different investigators. DOE

N87-16108# United Technologies Research Center, East Hartford, Conn.
IR FUEL/AIR CONTROL FOR METHANE COMBUSTORS Annual Report, May 1985 - May 1986
M. F. Zablielski, L. J. Daigle, and C. J. Egolf May 1986 60 p
(Contract GRI-5083-231-0492)
(PB87-102182; UTRC-956821-23A; GRI-86/0171) Avail: NTIS HC A04/MF A01 CSCL 07D

Two prototype, infrared, fuel/air controllers were constructed and tested. The testing consisted of bench testing of hardware components and software modules developed on a MACSYM 120 computer for use with small packaged boilers. In addition, the computer, electronics and software were used to control a laboratory fully premixed burner. One of the prototype controllers was installed on a 2.1x10 to the negative 6th power BTU/HR boiler. A magnetically driven butterfly fuel flow modulator was successfully used to dither the fuel flow on this boiler. Infrared signature data were obtained while viewing the flame from a headon location. These data were correlated with oxygen concentration measurements obtained at various fuel flows while adjusting air flow. The data indicated that the mixing in this boiler's dual burner required approximately 8% excess oxygen for near peak infrared emission when fired on natural gas. The data indicated that the concept was feasible on such a boiler. GRA

N87-16109# Battelle Pacific Northwest Labs., Richland, Wash.
SUPERCRITICAL FLUID CHROMATOGRAPHY FOR HIGH MOLECULAR WEIGHT ORGANIC ANALYSIS Final Report, Sep. 1983 - Jun. 1984
B. W. Wright, H. R. Udseth, and R. D. Smith Oct. 1986 58 p
(Contract EPA-68-02-3628)
(PB87-110524; EPA-600/2-86-092) Avail: NTIS HC A04/MF A01 CSCL 07D

The report describes a preliminary application of supercritical

fluid mass spectrometry (MS) techniques to the analysis of a middle distillate fuel, an emission particulate extract, and the emission particulates themselves. These techniques include capillary column supercritical fluid chromatography (SFC) (alone) and coupled with MS, direct fluid injection (DFI)/MS, and supercritical fluid extraction (SFE)/MS. These techniques are still in an early stage of development, but have demonstrated considerable potential for difficult analytical problems. The present work shows the feasibility of achieving high resolution separations of complex mixtures with SFC using nonpolar CO2 as the mobile phase. Additionally, these analyses have: provided an evalution of the limitations of the present defector interfaces, resulted in further design improvements, and emphasized research areas for further investigation. The present work also shows that SFC/MS application to complex mixtures can provide good separations and usable mass spectra. GRA

N87-16110# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
THE USE OF SURFACE ENHANCED RAMAN SPECTROSCOPY TO INVESTIGATE THE SURFACE CHEMISTRY OF CHROMIUM OXIDE FILMS
P. R. Graves Mar. 1986 26 p
(AERE-R-12146) Avail: NTIS HC A03/MF A01

A new method of surface spectroscopy was used to investigate the surface chemistry of chromia films. It was shown for the first time that surface enhanced Raman scattering (SERS) can be excited from physically modified chromia surfaces. A modulated silver layer with a periodicity of 0.25 to 0.5 micrometers was deposited on RF sputtered chromia films and on pre-oxidized chromium metal coupons. The SERS obtained from these films show that the chemistry of their surfaces is quite different from the bulk materials. Surface sites on RF sputtered chromia films are most likely to be Cr(5+)-O sub2(2-) whereas films formed by pre-oxidation have surface sites which are probably Cr(5+)-O (2-). Author

N87-16768*# Huntingdon Coll., Montgomery, Ala. Dept. of Chemistry.
DEVELOPMENT OF AC IMPEDANCE METHODS FOR EVALUATING CORRODING METAL SURFACES AND COATINGS
Ward Knockemus *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99) Avail: NTIS HC A99/MF E04 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N87-16111 Brown Univ., Providence, R. I.
TEMPERATURE PROFILE MEASUREMENT DURING SHEAR BAND FORMATION IN STEELS AT HIGH STRAIN RATES Ph.D. Thesis
Kathleen Ann Hartley 1986 123 p
Avail: Univ. Microfilms Order No. DA8617573

A ten element indium antimonide detector array was employed to measure the developing temperature profile as a shear band formed. Temperature measurements were effected by monitoring the infrared radiation emitted from the surface of a specimen during dynamic deformation in a torsional Kolsky bar. A number of steels were tested at a nominal strain rate from 1000 to 4000/sec. It was found from the present tests that shear bands are accompanied by large temperature gradients and that these gradients continue to grow with further deformation. An analytical model using parameters derived from the stress strain curves predicts accurately both the temperature profile across the gage section for the 1018 steel and the critical strain for shear localization in both of the steels. A few preliminary tests were performed with three AISI 1215 steels containing different MnS inclusion morphologies. It was found that, despite the similar quasi-static and dynamic stress strain curves of the three steels, one steel showed the formation of multiple shear bands across the gage length while the other did not. The steel that formed multiple bands was the one that had the highest inclusion aspect ratio. Dissert. Abstr.

N87-16112 ESDU International Ltd., London (England).
THE EFFECT OF ELECTRODEPOSITED CHROMIUM ON THE FATIGUE STRENGTH OF LOW ALLOY STEELS
Dec. 1986 16 p
(ESDU-86033; ISBN-0-85679-585-2; ISSN-0141-4089; ISSN-0141-3996) Avail: ESDU

Information is provided on the effect of chromium electroplating on the fatigue strength of low alloy steels. The results of over 100 fatigue tests on chromium plated steels of various tensile strengths are given. Also, as chromium electroplating normally has a detrimental effect on the fatigue strength of a steel, guidance is given on the effect of various alleviation treatments. ESDU

N87-16113*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MORPHOLOGY OF ZIRCONIA PARTICLES EXPOSED TO D.C. ARC PLASMA JET
Isidor Zaplatynsky Jan. 1987 17 p
(NASA-TM-88927; E-3325; NAS 1.15:88927) Avail: NTIS HC A02/MF A01 CSCL 11F

Zirconia particles were sprayed into water with an arc plasma gun in order to determine the effect of various gun operating parameters on their morphology. The collected particles were examined by XRD and SEM techniques. A correlation was established between the content of spherical (molten) particles and the operating parameters by visual inspection and regression analysis. It was determined that the composition of the arc gas and the power input were the predominant parameters that affected the melting of zirconia particles. Author

N87-16114# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A DIFFERENTIAL SCANNING CALORIMETRY STUDY OF GUINIER PRESTON ZONE FORMATION AND DISSOLUTION IN 7075 AND 7091 ALUMINUM ALLOYS Final Report
William Frazier 30 Dec. 1985 23 p
(AD-A171881; NADC-85169-60) Avail: NTIS HC A02/MF A01 CSCL 11/6

The aging behavior of P/M 7091 and IM 7075 aluminum were studied by DSC. Hardness and conductivity was studied also. The energy associated with the formation and dissolution of Guinier Preston zones is correlated to mechanical and physical properties; equations for conductivity and hardness as a function of heat of reaction are presented. The activation energy fo GP dissolution was established by differential scanning calorimetry (DSC) and values for delta H*, deltaG*, and deltaS* were calculated using absolute reaction rate theory. The activation energy calculated for GP disolution in 7075-T6 is equivalent to the activation energy reported for the diffusion of Zn in aluminum. GRA

N87-16115# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MECHANISM OF ELECTRICAL EROSION OF METALS
S. L. Mandelshtam and S. M. Rayskiy 25 Aug. 1986 40 p Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya (USSR), v. 13, no. 5, 1949 p 549-555; 557-561; 563-565
(AD-A171889; FTD-ID(RS)T-0793-86) Avail: NTIS HC A03/MF A01 CSCL 09/3

With some forms of electrical discharge, in particular in condensed spark discharge, as is known, it occurs extensive destruction of both of electrodes or one of them. This phenomenon, which obtained the name of electrical erosion, plays in the series/row of the practical applications of discharge very harmful role. It leads to the intense decomposition of high-voltage switches, contacts of relay, candles of the internal combustion engines and

other discharge tools. At the same time, recently this phenomenon began to be utilized for metal working. GRA

N87-16116# Ohio State Univ., Columbus. Research Foundation.
STRENGTH AND STRUCTURE OF Ga(1-x)In(x)As ALLOYS Quarterly Report, 1 Jan. - 31 Mar. 1986
Katherine T. Faber and John P. Hirth Apr. 1986 33 p
(Contracts F49620-85-C-0129; ARPA Order 5526; DA Proj. 5526)
(AD-A171897; AFOSR-86-0639TR; QR-2) Avail: NTIS HC A03/MF A01 CSCL 11/6

The strengthening effect of GaAs by indium additions is under examination. Solid solution strengthening by InAs4 solute units has been predicted and is studied via mechanical measurements complemented by electron microscopy. In this second quarterly report, hardness measurements for three Ga1-xInxAs compositions from R. T. to 900 C are complete and the second stage of the experimental work, compression testing, as a function of temperature and strain rate, is underway. GRA

N87-16117# Northeastern Univ., Boston, Mass. Barnett Inst. of Chemical Analysis and Materials Science.
ALLOY DEVELOPMENT, PROCESSING AND CHARACTERIZATION OF DEVITRIFIED TITANIUM BASE MICROCRYSTALLINE ALLOYS Annual Report, Sep. 1984 - Aug. 1985
Sung H. Whang Jan. 1986 17 p Prepared in cooperation with Polytechnic Univ., Brooklyn, N.Y.
(Contract N00014-82-K-0597)
(AD-A172140) Avail: NTIS HC A02/MF A01 CSCL 11/6

The effect of rapid solidification on solid solubility, microstructural refinement and phase transformation in binary and ternary titanium alloys was studied. The stability of the refined microstructures produced by rapid quenching were investigated under the isothermal and isochronal conditions. In particular, Ostwald ripening of rare earth (Y, La, Er) and Thorium dispersoids in Ti-Sn-X (Y, La, Er, Th) systems at elevated temperatures (700 to 900 C, phase) was investigated by transmission electron microscopy and image analyzer. The grain growth rate at the presence of the rare earth and Th dispersoids was investigated and determined as a function of time. The deterioration of microhardness in the ternary alloys containing rare earth dispersions upon high temperature annealing was studied in relation to microstructural coarsening. GRA

N87-16118# Army Materials Technology Lab., Watertown, Mass.
MECHANICAL PROPERTY CHARACTERIZATION OF VASCOMAX T-250 Final Report
Charles F. Hickey, Jr. and Timothy S. Thomas Jul. 1986 29 p
(AD-A172891; MTL-TR-86-30) Avail: NTIS HC A03/MF A01 CSCL 11/6

This report addresses a mechanical property characterization of VascoMax T-250 in the form of a 3-inch-diameter forged bar. Data were generated for aging temperatures of 850, 900, and 950 F and for aging times of 3, 4, 8 hours. Parameters addressed were hardness, tensile properties, Charpy V-notch impact energy and fracture toughness. Microstructural aspects were also addressed. Results indicate that for the heat treatments investigated the tensile strength increases with increasing aging temperature and time. Fracture toughness (k sub IQ) increases with aging temperature, and Charpy energy is the highest in the 950 F aged condition. Based on these findings the 950 F aging temperature results in the maximum tensile strength and toughness properties for the material in 3-inch-diameter bar form. Discrepancies in some of the tensile strength data and tensile fracture appearances are attributed to exogenous inclusions peculiar to this heat. GRA

N87-16119# Naval Postgraduate School, Monterey, Calif.
EFFECT OF THERMOMECHANICAL PROCESSING ON THE ELEVATED TEMPERATURE BEHAVIOR OF LITHIUM-CONTAINING HIGH-Mg, Al-Mg ALLOYS M.S. Thesis
Stephen B. Oster Jun. 1986 81 p
(AD-A174005) Avail: NTIS HC A05/MF A01 CSCL 11/6

An experimental investigation was conducted to determine the mechanical properties and microstructural characteristics resulting from thermomechanical processing by warm rolling of an Al-8.0%Mg-0.5%Zr Alloy and an Al-8.0%Mg-1.0%Li-0.15%Zr Alloy. At ambient temperature, yield strengths were 38 to 44 Ksi (262-303 MPa), ultimate tensile strengths were 60 to 65 Ksi (414-450 MPa), with 10-12% elongation to fracture. Both alloys were moderately superplastic at 300C; an elongation of 340% was attained with the 1.0%Li alloy. Behavior of the alloy is consistent with continuous recrystallization during annealing and deformation at warm temperatures, and is very similar to that of previously studied Al-Mg-X alloys. GRA

N87-16120# Georgia Univ., Athens. Dept. of Chemistry.
METAL CLUSTER TOPOLOGY. 5: INFINITE DELOCALIZATION IN ONE AND TWO DIMENSIONS: LANTHANIDE AND EARLY TRANSITION METAL HALIDE CLUSTERS BUILT FROM FUSED OCTAHEDRA
R. B. King 13 Nov. 1986 25 p
(Contract N00014-84-K-0365)
(AD-A174201; TR-34) Avail: NTIS HC A02/MF A01 CSCL 07/2

Graph theory derived models for metal cluster bonding can be extended to infinite one dimensional chains and infinite two dimensional sheets of fused metal octahedra using lanthanide and early transition metal halide clusters as examples. Discrete octahedral metal clusters have the following skeletal bonding topologies distinguished by their electron counts: (1) Twelve edge-localized two-center bonds as in the Mo6(Mu3-X)8L6(4+) clusters; (2) Eight face-localized three-center bonds as in the Nb6(Mu2-X12)L6(2+) clusters; (3) Globally delocalized bonding with six two-center core bond as in the octahedral boranes, carboranes, and metal carbonyl clusters (e.g., Rh6(CO)16) and the zirconium octahedron clusters with light interstitial atoms such as Zr6Cl12Be, Zr6Cl13Be(-), Zr6Cl16Be(4-), Zr6Cl13B, Zr6Cl14B(-), Zr6Cl15B(2-), Zr6Cl14C, and Zr6Cl15N. The infinite one dimensional chains of fused octahedra in Gd2Cl3 as well as the infinite two dimensional sheets of fused octahedra in the zirconium monohalides have electron and orbital counts corresponding to six-center core bonds in each octahedral cavity and multicenter bonds in the two tetrahedral cavities for each octahedral cavity. A similar bonding model for bulk metals leads to the prediction of maximum heats of atomization for the group 6 metals. GRA

N87-16121# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE VARIABILITY OF FATIGUE CRACK GROWTH LIFE OF ALUMINUM CASTING ALLOY A357-T6 Final Report, Apr. 1984 - May 1986
J. D. Tirpak 1 Jul. 1986 69 p
(AD-A174279; AFWAL-TR-86-4115) Avail: NTIS HC A04/MF A01 CSCL 11/6

This investigation considers the variability of fatigue crack growth (FCG) life of A357-T6. The life variability for this cast aluminum alloy is greater than the variability of 2024-T3, a wrought aluminum alloy. Dendrite arm spacing (DAS), dendrite cell size (DCS), porosity and silicon particle aspect ratios are measured to characterize the test specimens. Metallographic and fractographic analyses are performed to aid potential correlations between microstructure and discontinuities and fatigue behavior. Several recommendations are made for future efforts. GRA

N87-16122# Pratt and Whitney Aircraft, East Hartford, Conn. Engineering Div.
RAPID SOLIDIFICATION AND CONSOLIDATION OF IRON BASE ALLOYS Final Report, 1 Sep. 1984 - 31 Jul. 1986
R. G. Bourdeau Sep. 1986 12 p
(Contract N00014-84-C-0440)
(AD-A174475; PWA-FR-19546) Avail: NTIS HC A02/MF A01 CSCL 11/6

Rapidly solidified powders of iron base and steel compositions were produced and consolidated for the Massachusetts Institute of Technology (MIT) for use on a companion ONR program. A total of seven compositions were converted to rapidly solidified

powder in a P&W experimental rotary atomization device. The powders were screened, canned in extrusion containers, extruded to bar stock and delivered to MIT. Manganese containing TRIP steels and an iron base alloy were produced with refined structures where the contaminants in the steel such as sulfides were finely dispersed. Lanthanum added to the alloy steel gettered the phosphorus and refined phosphides as well as oxysulfides were produced for grain coarsening resistance. The latter steel is being evaluated in sharp-crack k sub IC toughness and k sub ISCC stress corrosion resistance. In addition, Fe-Ni base compositions were produced which are being used to study the effect rapid solidification in as solidified material. GRA

N87-16123# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgical Engineering and Materials Science.
FUNDAMENTAL STUDIES OF BETA PHASE DECOMPOSITION MODES IN TITANIUM ALLOYS Interim Technical Report, 1 Oct. 1984 - 30 Sep. 1985
H. I. Aaronson, A. M. Dalley, T. Furuhara, H. J. Lee, and N. Nityanand 24 Jan. 1986 58 p
(Grant AF-AFOSR-0303-84)
(AD-A174532; AFOSR-86-2010TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

A TEM study of the interphase boundary structure of pro-eutectoid alpha plates in a Ti-7.15% Cr alloy has shown that both the broad faces and edges of the plates are partially coherent. At the broad faces, misfit dislocations are 1/3 group of zone axes /1120/ whereas at the edges they are 1/3 group of zone axes /1123/. For normal alpha plates, the dislocations are ca. 20 nm apart at the broad faces and 8 nm apart at the edges. At black plates, the low temperature morphological variant of proeutectoid alpha, the dislocations are ca. 35 nm apart. Growth ledges are typically 100 to 350 nm apart at the broad faces of normal plates and ca. 700 nm apart on black plates. A detailed O-lattice analysis has demonstrated that a simple correlation between the misfit dislocation and the growth ledge structures does not exist. Growth kinetics studies of grain boundary allotriomorphs in Ti-3.9 w/o Co and Ti-7.15 w/o Cr have shown for the first time that the rejector plate mechanism is operative when the matrix phase has a bcc crystal structure. As previously predicted, however, this mechanism accelerates growth substantially less at a given homologous temperature than previous work has shown it to do in fcc matrices. The feasibility of detailed fundamental studies of the influence of beta grain size upon the development of Widmanstatten alpha sideplates has been demonstrated. Preliminary observations have been made on sideplate evolution from grain boundary allotriomorphs by both local morphological instability and sympathetic nucleation. GRA

N87-16124# Illinois Univ., Urbana. Dept. of Materials Science.
RAPID SOLIDIFICATION PROCESSING AND POWDER METALLURGY OF Al ALLOYS Final Technical Report, 15 Apr. 1982 - 15 Apr. 1985
Hamish L. Fraser 29 Oct. 1986 76 p
(Grant AF-AFOSR-0186-82)
(AD-A174553; AFOSR-86-1099TR) Avail: NTIS HC A05/MF A01 CSCL 11/6

Regarding the development of microstructure during rapid solidification, three areas have been addressed. The first involved a determination of the mechanism of formation of the so-called zones A and B in hyper-eutectic Al-transition metal alloys. The second area concerns submerged phase transformations. In Al-Be hyper-eutectic alloys, solidification proceeded by a set of phase transformations that may be described by a monotectic reaction. The third area of study involves quasi-crystalline Al alloys. Work done in this program has concentrated on the potentially beneficial aspects of quasi-crystalline phases in the microstructure of Al alloys. Work on the consolidation of particulate has concentrated on the use of conventional techniques (extrusion) and novel processes (dynamic compaction). An estimate of the mechanical properties of rapidly solidified Al alloys has been obtained. The effect of extrusion is to cause decomposition of the rapidly solidified microstructure. A comparison has been made, using the alloy Al-8Fe-2Mo, between the tensile properties of the decomposed microstructure (extruded) and subscale test specimens produced by laser surface melting, consisting entirely of Zone A. GRA

N87-16125# Sandia National Labs., Albuquerque, N. Mex.
STRENGTH IMPROVEMENT IN BETA" ALUMINA BY INCORPORATION OF ZIRCONIA
Steven N. Heavens (Chloride Silent Power Ltd., Runcorn, England) 1986 15 p Presented at the 3rd International Conference on the Science of Technology of Zirconia, Tokyo, Japan, 9 Sep. 1986 Prepared in cooperation with Chloride Silent Power Ltd., Runcorn (UK)
(Contract DE-AC04-76DP-00789)
(DE86-013575; SAND-86-7115C; CONF-860968-1) Avail: NTIS HC A02/MF A01

Beta double prime alumina ceramic electrolytes for use in Na/S batteries are inherently weaker than most engineering ceramics due to the presence of weakly-bonded conduction planes in the crystal structure and to difficulties in controlling grain growth during firing. Substantial improvement in microstructural control is obtained by incorporation of m-ZrO2 or PSZ, resulting in increases in strength and fracture toughness to around 350 MPa and 4 MPam(sup 1/2) respectively. PSZ may adversely influence the electrical resistivity of the ceramic owing to the presence of impurities. With most zirconia powders a high level of retention of t-ZrO2 is obtained at levels of addition up to 15% by weight ZrO2. At these levels ZrO2/beta double prime-Al2O3 ceramics show low resistivity and stable resistance in Na/S cells. DOE

N87-16126# Japan Atomic Energy Research Inst., Tokyo.
THERMAL SHOCK TESTING OF TiC-COATED MOLYBDENUM WITH PULSED HYDROGEN BEAMS
Kazuyuki Nakamura Jul. 1985 16 p In JAPANESE Prepared in cooperation with Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment
(DE86-703310; JAERI-M-85-089) Avail: NTIS (US Sales Only) HC A02/MF A01

Thermal shock testing of molybdenum samples, on which TiC is coated by TP-CVD and CVD methods, was made by using a pulsed hydrogen beam. The power density applied was 2 kw/cm. The test results showed that TiC coatings did not exfoliate until the melting of the substrate and showed good adhesion under the thermal shock conditions. DOE

N87-16127# Japan Atomic Energy Research Inst., Tokyo.
LOW CYCLE FATIGUE BEHAVIOR OF TITANIUM CARBIDE COATED MOLYBDENUM
Hiroshi Nishi, Tatsuo Oku, Tsuneo Kodaira, and Toshihiko Kikuyama Sep. 1985 31 p In JAPANESE; ENGLISH summary Prepared in cooperation with Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment
(DE86-703311; JAERI-M-85-144) Avail: NTIS (US Sales Only) HC A03/MF A01

Sintered molybdenum coated by TiC is used for the first wall such as a troidal fixed limiter and a magnetic limiter plate in JT-60, that is being operated at JAERI presently. This report describes the low cycle fatigue behavior of sintered molybdenum and the influence of TiC coating on fatigue strength. The low cycle fatigue test was conducted at room temperature and 500 C. The test results was also analyzed by fractographic observation, metallography and element analysis using EPMA. The low cycle fatigue strength of the molybdenum coated by TiC at 500 C is decreased compared with the one at room temperature. DOE

N87-16128# Allied Bendix Corp., Kansas City, Mo.
ANALYSIS OF LOW ALLOY STEELS BY WAVELENGTH DISPERSIVE X-RAY SPECTROMETRY Final Report
W. G. Frede Aug. 1986 22 p
(Contract DE-AC04-76DP-00613)
(DE86-015115; BDX-613-3555) Avail: NTIS HC A02/MF A01

A method was developed to determine the concentrations of silicon, phosphorus, chromium, manganese, nickel, and molybdenum in low alloy steels by using wavelength dispersive X-ray

spectrometry. This method incorporates the use of a 24-position sample carousel for unattended operation and a minicomputer for data collection and analysis. The concentration of the six elements of interest is calculated using a fundamental parameters computer program for X-ray fluorescence analyses. DOE

N87-16129# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Materials Engineering.
TESTS AND MODELING FOR SINTERING THEORY: EXPERIMENTAL TESTS TO UNIFY SINTERING THEORY Final Progress Reports, May 1982 - Apr. 1986
R. H. Doremus and R. M. German Jul. 1986 14 p
(Contract DE-FG02-84ER-45086)
(DE86-015459; DOE/ER-45086/1) Avail: NTIS HC A02/MF A01

Experimental emphasis was on measurements of particle, grain and pore sizes during heating, supplemented by dilatometry measured shrinkage during constant heating rate experiments. Additionally, measurements were made of the surface area, and examinations were conducted using TEM and SEM. The experiments were conducted on materials formed by precipitation from aqueous solution and on commercially available powders. Mixtures of alumina and various species (such as chromia) were milled and compared with pure alumina. Significant differences exist between the computational models and the actual sintering behavior of alumina-based systems. For example, we observed that plastic flow was occurring in the smaller precipitated powders. Furthermore, the computer simulation was accurate in predicting the bulk properties such as shrinkage and surface area loss; however, agglomerates of unsintered alumina were observed after high temperature sintering. Additional research has been conducted on fundamental interactions between mixed phases during sintering. Also, fundamental calculations have been performed to predict the capillary force when a liquid is present during the initial stage of sintering. Finally, considerable attention has been directed to predicting the behavior of mixed phase systems. Binary phase diagrams have proven useful in determining the possible sintering reactions. DOE

N87-16130# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
COATINGS FOR GAS TURBINES BY SPUTTER ION PLATING
D. S. Rickerby and M. I. Wood (Royal Aircraft Establishment, Farnborough, England) Apr. 1986 23 p
(AERE-R-12201) Avail: NTIS HC A02/MF A01

Commercially available coating processes used to deposit MCrAlY overlay compositions onto the hot end components of gas turbines are discussed. These are compared with sputter ion plating, a potentially cheaper and simpler alternative method which has been developed with a view of overcoming some of the limitations shown by the current commercial processes. Particular advantages of sputter ion plating technology include good control of coating composition, no need to rotate the components to be coated and deposition in a clean environment. The effect of peening on coating microstructure, and the subsequent oxidation behavior of the coating, has been examined for a range of MCrAlY compositions. Peening serves to eliminate leader defects from the surface layers by compaction of the coating and also affects the oxide-growth mechanisms. The surface roughness of the SIP coatings, both as-deposited and after glass bead peening, increases with that of the substrate and compares favorably with published values for electron beam evaporated coatings. In addition to protecting the base alloy, coatings must be resistant to thermal fatigue and results are presented for coatings deposited onto UDS superalloys cycled between 1020 C and room temperature using fluidized beds. Author

N87-16131# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
INTERNAL STRESS AND ADHERENCE OF TITANIUM NITRIDE COATINGS
D. B. Rickerby, B. A. Bellamy, and A. M. Jones Apr. 1986 24 p
(AERE-R-12204) Avail: NTIS HC A02/MF A01

Titanium nitride coatings were deposited on various substrates by sputter ion plating and the state of stress was determined by the sin squared psi method. The lattice distortions which occur in the nitride coatings have been resolved in terms of a macrostrain and microstrain, determined from the breadth of the X-ray reflections, and the origins of each are discussed. The internal stress present in a coating is shown to consist of two components, one thermal in origin and the other structural, and that its sign and magnitude varies with substrate material and bias potential. During cooling from deposition temperature partial relaxation of this internal stress (macrostrain) occurs via two mechanisms, plastic deformation of the substrate and yield of the film. The internal stress was completely relaxed on dissolution of the substrate, accompanied by a decrease in the lattice parameter of the film. By comparing the results from substrates biased and unbiased during deposition, and measurements made on adherent and free-standing coatings, the microstrain measurements have been separated into two parts, one due to distortions at the grain boundaries and one due to defects in the crystallites. A model is proposed which accounts for all the experimental observations; this also provides an explanation for the distortions from cubic symmetry reported in titanium and hafnium nitride films. Author

N87-16132# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics and Materials Development Div.
AN INVESTIGATION OF THE HIGH TEMPERATURE OXIDATION OF A 20%Cr/25%Ni/Nb STAINLESS STEEL IN CARBON DIOXIDE USING THIN LAYER ACTIVATION
J. Asher, S. Sugden, M. J. Bennett, R. W. M. Hawes, D. J. Savage, and J. B. Price May 1986 17 p
(AERE-R-12196; AGR/FPWG/P(84)587; ARPWG/P(86)16) Avail: NTIS HC A02/MF A01

The high temperature oxidation behavior of a 20% Cr/25% Ni/Nb stainless steel, during isothermal exposures of up to 525 h duration, in carbon dioxide, at 900 and 950 C and on subsequent furnace cooling, has been studied by weight change measurements, in combination with thin layer activation. For this purpose a defined region of the steel was activated by a deuteron beam to produce the radioisotopes Cr51, Mn52, Mn54, Co56, Co57 and Co58, with independent depth distributions to 70 microns. Measurements of the activity levels of the radioisotopes before, during and after oxidation, monitored scale spallation, thus enabling effects on the oxidation kinetics due to scale cracking to be distinguished. The involvement of each radioisotope was ascertained in the types of scales formed and in the spall produced. Author

N87-16133# United Kingdom Atomic Energy Authority, Harwell (England). National NDT Centre.
MICROSTRUCTURAL MONITORING BY LASER-ULTRASONIC ATTENUATION AND FORWARD SCATTERING
C. B. Scruby, R. L. Smith, and B. C. Moss Jan. 1986 21 p
(AERE-R-11953) Avail: NTIS HC A02/MF A01

Laser generation and reception techniques have been used for non-contact measurement of frequency dependent ultrasonic attenuation in steels with different microstructures. In addition, the forward-scattered ultrasonic energy from microstructural discontinuities has been detected and characterized with reference to its amplitude and frequency content. It was found that a fine microstructure (small grain-size) causes less high frequency attenuation than a coarse microstructure, in agreement with the results of previous studies using contact piezoelectric transducers. Furthermore, the coarser microstructure produced higher amplitude forward scattering in the frequency range 4 to 25 MHz. These results could form the basis of a non-destructive method for monitoring materials quality during manufacture. Author

N87-16134# United Kingdom Atomic Energy Authority, Harwell (England). Materials Physics and Metallurgy Div.
A PHYSICAL APPROACH TO THE AUTOMATED ULTRASONIC CHARACTERISATION OF BURIED WELD DEFECTS IN FERRITIC STEEL
S. F. Burch and N. K. Bealing Jan. 1986 34 p
(AERE-R-12051) Avail: NTIS HC A03/MF A01

The problem of automatically discriminating both smooth and

rough cracks from more benign volumetric flaws such as porosity and slag, using pulse-echo ultrasound is discussed. Unlike many previous approaches, digital ultrasonic data were collected from tranducers scanned over the whole of each reflector. Scans were also made using different angles of ultrasound. Qualitative physical models for the interaction of ultrasound with these defects are developed to identify three independent effects that, together, could be used to distinguish between these four classes of defect. Each effect is quantified by numerical features computed from the ultrasonic data and criteria are developed to select one feature for each effect. Automated defect classification is then achieved by a weighted minimum distance pattern recognition algorithm. The preliminary application of this approach to a database containing feature values from 40 buried defects in ferritic steel welds gave a classification success rate of 100 percent. Author

N87-16135# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
THE LASER RAMAN MICROPROBE: A NEW TECHNIQUE FOR THE IDENTIFICATION OF CORROSION SCALE CONSTITUENTS
P. R. Graves, M. J. Bennett, and R. W. M. Hawes Feb. 1986 19 p
(AERE-R-12037; AGR/FPWG/P(86)736) Avail: NTIS HC A02/MF A01

The effectiveness of a laser Raman microprobe, with a two micron spot size and 1 to 2 micron probe depth, to provide microcompositional information about corrosion scales has been assessed. The examination was made of 20%Cr/25%Ni/Nb and 20%Ni/Nb + 0.13%Ce stainless steels oxidized in carbon dioxide based gases. For the first time it has proved possible to establish the unidirectional variation in the constituent phases of a thin (approx. less than 1 micron) oxide scale and also to identify precisely the nature of the oxide layers comprising thicker (8 approx. less than 8 micron) scales. Author

N87-16136 United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
SOME FUNDAMENTAL STUDIES OF METAL-INDUCED EMBRITTLEMENT
P. Trevena and S. P. Lynch Nov. 1985 21 p
(AERE-R-11962) Copyright. Avail: Issuing Activity

A study has been made of the effects of liquid alkali metal environments on the fracture behavior of nickel, magnesium and single crystals of iron-silicon alloy. Liquid lithium and sodium environments were shown to promote embrittlement of one or more of the solid metals. Fractography revealed ductible dimpling, intergranular and transgranular fracture, the proportions of which varied with environment and test conditions. Liquid metal embrittlement (LME) of nickel and the iron-silicon alloy showed remarkable fractographic similarities to hydrogen embrittlement (HE). LME of magnesium revealed features which are similar to fractures induced by stress corrosion cracking (SCC). It is therefore proposed that the mechanisms of LME, HE and SCC are similar in these cases. In addition, double cantilever beam (DCB) test specimens were used to investigate the effect of solid indium on sub-critical crack growth rates of 7017-T651 aluminum alloy. Author

N87-16137 United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
A THEORETICAL STUDY OF THE USES OF EDDY CURRENT IMPEDANCE METHODS FOR THE MEASUREMENT OF CLADDINGS
R. P. Holt and K. D. Boness Feb. 1986 33 p
(AERE-R-11998) Copyright. Avail: Issuing Activity

The results of a study into the use of eddy currents to provide calibrated measurements of the thickness of one conductor clad upon another are presented. The study used a computer simulation to quantify the effects of varied thickness, resistivities, probe geometry and test frequency. Author

N87-16138# United Kingdom Atomic Energy Authority, Harwell (England). Materials Physics and Metallurgy Div.
THE EFFECTS OF COMPOSITION, PRECIPITATION AND SURFACE PREPARATION ON LATTICE AND GRAIN BOUNDARY DIFFUSION IN AISI TYPE 316 STAINLESS STEEL
C. M. Shepherd and S. M. Allan Apr. 1986 33 p
(AERE-R-12096) Avail: NTIS HC A03/MF A01

The volume and grain boundary diffusivities of Fe 55 have been measured in three experimental alloys based on AISI type 316 stainless steel. Changes in the concentrations of carbon and tin did not influence either the volume or grain boundary diffusivities. Using electropolishing to prepare the specimens prior to electroplating with the Fe 55 tracer reduced the measured values of both the volume and the grain boundary diffusivities. The published data for the diffusivity of iron in austenitic stainless steels is reviewed and discussed in relation to chemical composition and precipitation effects. Author

N87-16194# Joint Publications Research Service, Arlington, Va.
ARRIVAL OF TITANIUM AGE, FUTURE APPLICATIONS DISCUSSED
Takashi Muro *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 64-69 Transl. into ENGLISH from Nikko Materials (Tokyo, Japan), Jan. 1986 p 13-16 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

N87-16746*# Alabama Univ., Birmingham. Dept. of Materials Engineering.
GROWTH AND CHARACTERIZATION OF Hg(1-x)Zn(x)Se
R. N. Andrews *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 48 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials *see 24 Composite Materials.*

N87-16139 Carnegie-Mellon Univ., Pittsburgh, Pa.
A NEW APPROACH TO CHARACTERISTIC SURFACES IN ELASTIC-HARDENING-PERFECTLY PLASTIC MATERIAL IN THREE DIMENSIONAL SPACE Ph.D. Thesis
Renn-Min Guo 1986 223 p
Avail: Univ. Microfilms Order No. DA8616503

The derivation associated with the numerical solution for the three dimensional elastoplastic behavior is introduced. The characteristic equations of elastoplastic flow are solved on the basis of small deformation plasticity theory. Further investigation which leads to the understanding of the behavior of a type of material with a non-workhardening portion in its stress-strain curve relies on the development of the numerical method. A least square variational principle is introduced to conquer the difficulty resulting from the nonuniqueness of the relationship between the stress and the strain in the perfectly plastic mode. This novel methodology promises such high accuracy that even a coarse map may be used. A new computer core storage scheme is also proposed to minimize the required memory size. Thus, the finite element code EPA3D was built and verified by a number of numerical experiments. The elastic results compared with the analytical solution show the success of this computer program. The plastic results as well as the associated characteristic equations are further demonstrated and they agree with the theoretical prediction. The characteristic directions bear analogy to the shear band in experimental observations. The plastic response of two typical cases, the rectangular beam subjected to bending (plane strain case and pure bending case) and the circular disk subjected to torsion, are investigated. The results show success in keeping on the track of the stress-strain curve. The coarse map adapts to every test case because of the storage capability of the computer. Dissert. Abstr.

N87-16140*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF ATMOSPHERE ON THE TRIBOLOGICAL PROPERTIES OF A CHROMIUM CARBIDE BASED COATING FOR USE TO 760 DEG C Final Report
Chris DellaCorte and Harold E. Sliney 1986 20 p Proposed for presentation at the Annual Meeting of the American Society of Lubrication Engineers, 11-14 May 1987
(Contract DE-AI01-86CE-50162)
(NASA-TM-88894; DOE/NASA/50194-44; E-3311; NAS 1.15:88894) Avail: NTIS HC A02/MF A01 CSCL 11G

The effect of atmosphere on the tribological properties of a plasma-sprayed chromium carbide based self-lubricating coating is reported. The coating contains bonded chromium carbide as the wear resistant base stock to which the lubricants silver and barium fluoride/calcium fluoride eutectic are added. It has been denoted as NASA PS200. Potential applications for the PS200 coating are cylinder wall/piston ring couples for Stirling engines and foil bearing journal lubrication. Friction and wear studies were performed in helium, hydrogen, and moist air at temperatures from 25 to 760 C. In general, the atmosphere had a significant effect on both the friction and the wear of the coating and counterface material. Specimens tested in hydrogen, a reducing environment, exhibited the best tribological properties. Friction and wear increased in helium and air but are still within acceptable limits for intended applications. A variety of X-ray analyses was performed on the test specimens in an effort to explain the results. The following conclusions are made: (1) As the test atmosphere becomes less reducing, the coating experiences a higher concentration level of chromic oxide at the sliding interface which increases both the friction and wear. (2) Beneficial silver transfer from the parent coating to the counter-face material is less effective in air than in helium or hydrogen. (3) There may be a direct relationship between chromic oxide level present at the sliding interface and the friction coefficient. Author

N87-16141# Naval Academy, Annapolis, Md.
ION CONDUCTING POLYMERS AS SOLID ELECTROLYTES Final Report, 1985 - 1986
Jeffrey D. Semancik 28 May 1986 71 p
(AD-A171703; USNA-TSPR-139) Avail: NTIS HC A04/MF A01 CSCL 07/4

Electrically conducting polymers have recently been the subject of much interest. In particular, their potential as electrolytes in solid-state batteries has gained the attention of the U.S. Navy. Current ion-conducting polymers have conductivities which are too low by a factor of ten at operational temperatures. In order to be able to obtain suitable conductivities in these polymers, a thorough understanding of the mechanisms governing ion motion in them must be attained. The processes involved in the ion conduction of one particular polymer, poly(propylene oxide) or PPO, were studied in this research. Samples were prepared using an ion implantation procedure developed as part of the project as well as by the traditional chemical complexing technique involving alkali-metal salt doping. The samples produced were analyzed using both differential scanning calorimetry and audio frequency complex impedance measurements. Results indicate that the polarity of the salts has a major effect upon the activation volume and the glass transition of PPO. As a result of these effects, it seems that non-polar anions may aid in increasing the cationic transport number of the polymer. More importantly, the first direct numerical evidence of a connection between the large scale segmental motions of the polymer chains and the chains and the conductivity has been established. GRA

N87-16142# Naval Weapons Center, China Lake, Calif.
EXPANSION COEFFICIENT ON OXIDES AND OXIDE CERAMICS Final Report, Dec. 1984 - Jun. 1985
Josephine Covino May 1986 44 p
(AD-A171816; AD-E900596; NWC-TP-6663) Avail: NTIS HC A03/MF A01 CSCL 11/2

Expansion coefficients for existing oxides and oxide ceramics have been compiled. In some cases, where data is available, a description of how the thermal expansion coefficient was measured will be noted. GRA

N87-16143# Hughes Associates, Inc., Wheaton, Md.
FIRE PERFORMANCE EVALUATION OF SOLID AQUEOUS FILM-FORMING FOAM (AFFF) Final Report, Apr. 1984 - 14 Sep. 1985
Joseph L. Scheffey, Edwin J. Jablonski, Joseph T. Leonard, Joseph L. Walker, and Phyllis Campbell May 1986 42 p
(Contract N00014-84-C-2200; DA Proj. 2505)
(AD-A171943; AFESC/ESL-TR-85-33) Avail: NTIS HC A03/MF A01 CSCL 13/12

The fire performance of solid AFFF firefighting foam purchased from the 3M Company was determined and compared against the performance of liquid 3 percent concentrate which is on the Navy Qualified Products List (QPL). Twenty-eight and 50-square-foot fire tests specified in MIL-F-24385C were used to measure fire performance. A limited number of large-scale (1000-square-foot) fire tests were also conducted. Several mixing techniques were used to prepare solution samples at agent-to-water ratios of 6 grams per liter and 8 grams per liter. A total of 47 fire tests were conducted. In all tests, the fire was extinguished using solutions prepared with solid AFFF. These solutions averaged longer times to control and extinguish hydrocarbon fuel fires when compared to solutions prepared with 3 percent liquid AFFF concentrate. Less than desirable burnback and mixing characteristics were also identified. Because there is potential to achieve significant agent space and weight reductions by using a solid AFFF, additional testing and evaluation is recommended. Specific recommendations include evaluation of solutions prepared by increasing the solid agent-to-water ratio, or reformulation of the solid agent to improve performance. Super-concentrated AFFF (proportioned at 1 percent or less) and concentrates prepared by reconstituting a base AFFF formulation also have potential to reduce space and weight requirements compared to existing 3 and 6 percent AFFF concentrates. GRA

N87-16144# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
SURFACE FUNCTIONALIZED POLYETHYLENE FILM Final Report, Dec. 1982 - Jan. 1986
George M. Whitesides Jun. 1986 9 p
(Contract N00014-83-K-0142)
(AD-A172096; Rept-4) Avail: NTIS HC A02/MF A01 CSCL 07/3

This project has: (1) Developed practical methods for oxidizing the surface of low-density polyethylene film and introducing reactive organic functionality into this oxidized surface layer; (2) Explored new techniques for analyzing the surfaces of organic polymeric solids; Contact angle titration--the study of the contact angle of water on organic solids as a function of pH--has proved particularly useful and extremely surface sensitive; (3) Characterized a series of new phenomena occurring in thin organic surface layers, including thermal reconstruction of the surface (a process during which functional groups in the surface migrate into the deeper parts of the polymer); (4) Examined the basic physical organic chemistry of wetting of organic solids; and (5) Applied the information from these studies to the synthesis of new interface-modifying agents, especially for adhesion promotion. GRA

N87-16145# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
A REEXAMINATION OF SINGLE CHAIN SCATTERING IN HETEROGENEOUS BLOCK COPOLYMERS
C. V. Berney, P. Kofinas, and R. E. Cohen 1 Sep. 1986 12 p
(Contract N00014-77-C-0311)
(AD-A172457) Avail: NTIS HC A02/MF A01 CSCL 11/9

Calculations utilizing a scattering formalism due to deGennes are compared with previously-reported SANS data from two polystyrene-polybutadiene samples which have been blended with similar diblocks in which the B segment is deuterated. The present conclusion is that both the lower- and higher-molecular-weight samples exhibit scattering in excess of that predicted, presumably

due to clustering of the labelled chains or some other chain-length dependent phenomenon. GRA

N87-16146# Battelle Columbus Labs., Ohio.
THERMAL BARRIER COATINGS FOR ENGINE APPLICATIONS
J. A. Colwell Aug. 1986 25 p
(Contract DLA900-83-C-1744)
(AD-A172983; MCIC-86-C2) Avail: NTIS HC A02/MF A01 CSCL 11/3

The benefits of using thermal barrier coatings for engine applications have been considered. It has been found by a number of investigators that engine efficiencies can be dramatically improved by the use of these coatings. Most of the work done in the past was centered around the use of plasma-sprayed zirconia as the basis of the coating system. Various bond coats, needed for adherence and corrosion resistance, and concentrations of oxide stabilizers have been investigated. It appears that an MCrAlY bond coat beneath a zirconia coating containing 6 to 8 percent yttria as stabilizer is the most promising candidate for heat engine service. Coating adherence during thermal cycling and corrosion resistance of both the coating system and the underlying alloy substrate are of prime importance. GRA

N87-16147# Akron Univ., Ohio. Inst. of Polymer Science.
BLOW-OFF PRESSURES FOR ADHERING LAYERS
A. N. Gent and L. H. Lewandowski Nov. 1986 36 p
(Contract N00014-85-K-0222)
(AD-A172997; TR-7) Avail: NTIS HC A03/MF A01 CSCL 11/1

An analysis is given of the critical internal pressure P at which a circular debond blister will grow in size, in terms of the tensile modulus E and thickness t of an adhering layer, and the strength G sub a of its adhesion to a rigid substrate. Measurements of blow-off pressure are reported for adhering layers of pressure-sensitive tapes having widely-different effective modulus and thickness, and with blisters having a range of diameters. Satisfactory agreement is obtained with the theoretical predictions, suggesting that the theory is basically correct in assuming that relatively thin layers behave like elastic membranes. Attention is drawn to the unusual form of the dependence of the debonding pressure P upon the resistance Et of the layer to stretching and upon the detachment energy. Even though the adhering layer is assumed to be linearly- elastic, the markedly non-linear (cubic) relation between pressure P and volume V of the blister, or maximum height y, leads to this unusual result. The detachment energy is given by a particularly simple function of the pressure P and maximu m deflection of the blister: G sub a = 0.65 Py, independent of the stiffness of the adhering layer and diameter of the blister. GRA

N87-16148# Midwest Research Inst., Kansas City, Mo.
THE ROLE OF SURFACE FUNCTIONAL GROUPS IN ADHESIVE BONDING AT THE ARAMID-EPOXY INTERFACE
L. S. Penn, T. J. Byerley, and T. K. Liao 15 Sep. 1986 29 p
(Contract N00014-84-C-0522)
(AD-A172998; TR-1) Avail: NTIS HC A03/MF A01 CSCL 11/4

In polymeric composites, reactive functional groups on the fiber surface are assumed to greatly enhance the mechanical strength of the fiber-matrix interface by forming covalent bonds with the matrix. To test this assumption, we ought to promote covalent bonding at the aramid fiber-epoxy matrix interface by attaching flexible reactive pendent groups to the fiber surface. Other factors that could affect interfacial adhesion were kept constant, i.e., surface energy and surface topography. Quantitative analysis showed a pendent group attachment level of 1.5 to 4.5 groups per 100A sub 2 of fiber surface, a level that agrees well with the theoretical amount. Surprisingly, in adhesive performance tests, the presence of these reactive pendent groups did not improve the fiber-matrix interface strength. Specific chemical tests for covalent bond formation between the terminal amine of the pendent group and the epoxy molecule showed that covalent bonding did not occur, thus explaining the unexpected lack of improvement in adhesive performance. GRA

N87-16149# California Univ., Los Angeles.
PREPARATION PROPERTIES AND CHARACTERIZATION OF ULTRAPURE GLASSES AND CERAMICS Final Technical Report, 1 Jan. 1985 - 31 Jan. 1986
John D. MacKenzie Aug. 1986 16 p
(Grant AF-AFOSR-0121-85)
(AD-A172735; AFOSR-86-0877TR) Avail: NTIS HC A02/MF A01 CSCL 11/2

A unique glove box system has been built which permits the melting and fabrication of halide and chalcohalide glasses under controlled atmospheres. Glass fibers have been prepared inside this system and their tensile strengths and viscoelastic properties measured in situ. Further the microstructures of glasses and ceramics prepared as well as their infrared transmission were investigated without the need to expose the samples to the external atmosphere. The system has been used to perform research for the Air Force Office of Scientific Research and to train students in the preparation of ultrapure glasses and ceramics. GRA

N87-16150# Detroit Univ., Mich. Polymer Inst.
ENERGY ABSORPTION OF POLYURETHANE BASED POLYMER ALLOYS
Irfan Raza, Bhavesh Muni, Bijan Sedghi, Kurt C. Klempner, and Daniel Frisch 15 Sep. 1986 145 p
(Contract DAAG25-85-K-0129)
(AD-A172901; ARO-22361.2-MS) Avail: NTIS HC A07/MF A01 CSCL 11/9

Interpenetrating polymer networks (IPNs) elastomers and foams composed of polyurethanes and epoxies were prepared by the simultaneous technique. Fillers and plasticizers were incorporated by random batch mixing. The PU/epoxy ratio was varied. Enhanced energy absorbing abilities were demonstrated by the dynamic mechanical spectroscopy results (broad and high tan delta behavior as a function of temperature). This was reflected in the mechanical and acoustical energy absorption of the foams. The effects of fillers and plasticizers were mixed. GRA

N87-16151# National Bureau of Standards, Gaithersburg, Md. Ceramics Div.
STRESS CORROSION OF CERAMIC MATERIALS Annual Report, 1 Oct. 1984 - 30 Sep. 1985
S. W. Freiman, G. S. White, T. L. Baker, S. M. Wiederhorn, and T. D. Coyle 1 Aug. 1986 70 p
(Contract N00014-85-F-0021)
(AD-A173669) Avail: NTIS HC A04/MF A01 CSCL 11/2

The critical fracture energy and susceptibility to environmentally enhanced fracture were shown to depend on the bonding in single crystals. Fracture energy results agreed with predictions based on force laws. Additions of lithium to basic solutions reduced crack growth rates in silica by over an order of magnitude. KIC and subcritical crack growth in capacitor ceramics were in a function of composition and microstructure. Correlations between strength and dielectric aging rate were obtained for aplphia Z5U capacitor material. GRA

N87-16152# Duke Univ., Durham, N. C. Dept. of Chemistry.
NEMATOGENIC BLOCK COPOLYMERS OF RIGID AND FLEXIBLE AROMATIC UNITS. PART 1: SYNTHESIS AND CHARACTERIZATION
William R. Krigbaum, Jack Preston, A. Ciferri, and Z. Shufan 6 Nov. 1986 3 p
(Contract N00014-84-K-0496)
(AD-A173947; TR-1) Avail: NTIS HC A02/MF A01 CSCL 07/3

The phosphorylation reaction of Yamazaki and Higashi was used to prepare wholly aromatic block copolymers containing the rigid units poly(p-benzamide) (PBA) or poly(p-phenylene terephthalamide) (PPD-T) and the flexible units poly(m-phenylene isophthalamide) (MPD-I) or the polyterephthalamide of p-aminobenzhydrazide (PPD-T). Three synthetic procedures were investigated: (1) monomers of the flexible block were added to the rigid prepolymer, (2) monomers of the flexible block were added to the carboxy terminated rigid prepolymer, and (3) the reaction of the carboxy terminated prepolymer of the rigid block with amine terminated

prepolymer of the flexible block. Extraction of the copolymer with a non-solvent for the rigid homopolymer indicates that method (2) gives the smallest amount of the flexible homopolymer. The extract from the PBA/MPD-I block copolymer was shown to be the flexible MPD-I homopolymer by NMR. The extract from the PBA/PABH-T copolymer could not be characterized by NMR due to overlapping of the spectra, but differential scanning calorimetry was used to identify the extract as PABH-T. GRA

N87-16153# EIC, Inc., Norwood, Mass.
POLYDIOXOLANE POLYMER ELECTROLYTE
J. S. Foos and S. M. Erker 18 Oct. 1986 9 p
(Contract N00014-85-C-0790)
(AD-A174092; TR-1) Avail: NTIS HC A02/MF A01 CSCL 07/4

Polymer electrolytes formed by the chemical and electrochemical polymerization of a solution of LiAsF6 in dioxolane have been examined. The liquid electrolyte has been stabilized by preparing and storing it in the presence of Li metal as a proton and carbocation scavenger. The initial results show that the polymerization of the electrolyte is readily initiated chemically by acids or oxidizing agents. The polymerization continues so that the conductivity of the resulting polymer electrolyte decreases over 24 hrs at room temperature approaching .000001 S/cm. GRA

N87-16154# Carnegie-Mellon Univ., Pittsburgh, Pa.
PHYSICAL-CHEMICAL PROPERTIES OF ARTICULATED RODLIKE POLYMERS Final Report, 1 Sep. 1983 - 30 Aug. 1985
G. C. Berry, S. Mohan, C. Kim, R. Furukawa, and C. Wei 29 Aug. 1986 106 p
(Contract F33615-83-C-5044)
(AD-A174174; AFWAL-TR-86-4035) Avail: NTIS HC A06/MF A01 CSCL 11/9

Rheological and rheo-optical studies are reported on solutions of rodlike poly (1,4-phenylene 2,6-benzobisthiazole), PBT. Both isotropic and nematic solutions are studied, over a range of polymer concentration c, weight average chain length, and temperature. A single-integral constitutive equation is given that describes the rheological and rheo-optical properties of the isotropic solution. It is based on a memory function based on linear viscoelastic behavior and a strain measure that introduces nonlinear viscoelastic behavior under appropriate strain history. The behavior for the nematic fluid exhibits both similarities and differences with that given by the single-integral relation. In particular, the steady-state behavior at small shear rate is markedly different from that predicted, perhaps related to unstable shear flow of the nematic fluid. Rheological data are also given for mixtures of PBT and a nylon in solution. The results reveal marked effects on the rheological properties of the PBT solution, dependent on the nylon concentration. GRA

N87-16155# Rockwell International Science Center, Thousand Oaks, Calif.
FUSED SALT SYNTHESIS OF MATERIALS FOR IR (INFRARED) WINDOWS Technical Report, 1985 - 1986
P. Morgan and M. S. Koutsoutis Oct. 1986 11 p
(Contract N00014-85-C-0140)
(AD-A174226; SC5422.TR; TR-1) Avail: NTIS HC A02/MF A01 CSCL 11/2

The production of narrow size distribution, NaLaS2, for IR windows, using a fused salt technique is described. Materials for this application require erosion resistance, high hardness and strength with good thermal shock resistance. This type of very simple fused salt chemistry appears to be a viable approach to modern ceramic synthesis of monosize particles of complex sulfides or other chalcogenides. GRA

N87-16156# Pennsylvania State Univ., University Park. Materials Research Lab.
ULTRA-LOW THERMAL EXPANSION CERAMICS Final Report, Jul. 1983 - Jun. 1986
H. A. McKinstry, D. K. Agrawal, G. E. Lenain, C. S. Vikram, and S. Y. Limaye Aug. 1986 16 p
(Grant AF-AFOSR-0291-83)
(AD-A174530; AFOSR-86-2060TR) Avail: NTIS HC A02/MF A01 CSCL 11/2

The crystal chemistry, synthesis, and thermal expansion investigation of NZP-family was completed--in that M sup 1Zr2-P3O12 (M sup 1 = Li, Na, K, Rb, Cs), M sup 11 Zr4P6O24 (M sup 11 = Mg, Ca, Sr, Ba) and a few more compositions were studied. Single crystals of (NZP) and (CZP) were grown, and high-temperature X-ray measurements were made on these crystals to test the validity of a structural model to interpret thermal expansion data. The possibility of the development of a glass-ceramic of NaGe2P3O12 was explored. Dielectric measurements made on CaZr4P6O24 reveal that in general (NZP)-materials have a low dielectric constant. Three new families, namely diborides (ZrB2, TiB2, and CrB2), Al2O3-GeO2 system and perovskite Pb(Mg1/3Nb2/3)O3 were investigated in order to search for any new low thermal expansion composition, but not much success was achieved in this direction, except that some perovskite compositions displayed low alpha behavior at low temperatures. GRA

N87-16157# Oak Ridge National Lab., Tenn.
CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT Semiannual Progress Report, Apr. - Sep. 1985
May 1986 243 p
(Contract DE-AC05-84OR-21400)
(DE86-014332; ORNL/TM-9947) Avail: NTIS HC A11/MF A01

An assessment of needs was completed, and a five-year project plan was developed with input from private industry. The objective is to develop the industrial technology base required for reliable ceramics for application in advanced automotive heat engines. Focus is on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. The work described in this report is organized according to the following WBS project elements: management and coordination; materials and processing (monolithics, ceramic composites, thermal and wear coatings, joining); materials design methodology (contact interfaces, new concepts); data base and life prediction (time-dependent behavior, environmental effects, fracture mechanics, NDE development); and technology transfer. This report includes contributions from all currently active project participants. DOE

N87-16158# Argonne National Lab., Ill.
EFFECT OF MICROSTRUCTURE AND SURFACE CHARACTERISTICS ON PHASE STABILITY
S. K. Chan, A. T. Aldred, and M. V. Nevitt Apr. 1986 9 p
Presented at the World Congress on High Tech Ceramics: Electronic, Engineering, Nuclear, Biomedical Research and Applications in Focus, Milan, Italy, 23 Jun. 1986
(Contract W-31-109-eng-38)
(DE86-014491; CONF-860608-6) Avail: NTIS HC A02/MF A01

A theory is put forth according to which a category of ceramic materials that are susceptible to shear transformations of a continuous kind may be stabilized over a significant subcritical temperature range. The temperature range T sub c is a function of the grain size and the surface characteristics. Application of the theory is made to ceramic oxides of the type LaNb sub 1-x/V sub x O that undergo tetragonal/monoclinic shear transformations. Comparison with experiment indicates that a temperature range of stabilization T sub c approx. 200 deg. C is consistent with the theoretical model. DOE

N87-16159# Lawrence Livermore National Lab., Calif.
PREPARATION AND PROPERTIES OF POLYVINYL ALCOHOL MICROSPHERES
J. H. Campbell, J. Z. Grens, J. F. Poco, and B. H. Ives Jun. 1986 45 p
(Contract W-7405-eng-48)
(DE86-015111; UCRL-53750) Avail: NTIS HC A03/MF A01

Polyvinyl alcohol (PVA) microspheres, having a size range of approx. 150- to 250-micron diameter with 1- to 5-micron wall thickness, have been fabricated using a solution droplet technique. The spheres were developed for possible use on the Lawrence

Livermore National Laboratory (LLNL) Inertial Confinement Fusion (ICF) Program. PVA, a polymer chosen based on earlier survey work carried out at KMS Fusion, Inc., has good strength, low hydrogen permeability, is optically transparent, and water soluble. The latter property makes it safe and easy to use in our droplet generator system. A unique dual-orifice droplet generator was used to prepare the spheres. The droplet generator operating conditions and the column processing parameters were chosen using results from our 1-D model calculations as a guide. The polymer microsphere model is an extension of the model we developed to support the glass sphere production. After preparation, the spheres were physically characterized for surface quality, sphericity, wall thickness (and uniformity), and size. We also determined the buckling pressure for both uncoated and CH-coated spheres. Radiation stability to beta decay (from tritium) was evaluated by exposing the spheres to a 7-keV electron beam. The results from these and other physical property measurements are presented in this report. DOE

N87-16160# Argonne National Lab., Ill.
REVIEW OF THE EFFECT OF FLAWS ON THE FRACTURE BEHAVIOR OF STRUCTURAL CERAMICS
J. P. Singh Sep. 1986 35 p
(Contract W-31-109-eng-38)
(DE87-000909; ANL/FE-86-3) Avail: NTIS HC A03/MF A01

A literature review was conducted on the effect of flaws on the fracture behavior of structural ceramics. Both intrinsic flaws (inclusions, pores, large grains, grain boundaries, and agglomerates) and extrinsic (surface machining) flaws have been observed to influence the fracture behavior. Examination of several models to predict the effect of flaws on fracture behavior suggests that detailed evaluation of the microstructure is essential for the selection and/or development of appropriate models for a specific material. It has also been observed that in many cases, the initial flaw population changes in service as a result of the interaction between the service environment and the component. Implications of the understanding of the effect of flaws on fracture for the control of fabrication procedures are discussed. It is suggested that a collaborative effort, combining fracture and microstructural studies with nondestructive evaluation to detect and characterize these flaws, will be a critical step towards ensuring the structural reliability of ceramic components. DOE

N87-16195# Joint Publications Research Service, Arlington, Va.
RECENT TRENDS IN CERAMIC SOLID STATE DEVICES
Noboru Ichinose *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 70-79 Transl. into ENGLISH from Ceramics Japan (Tokyo, Japan), Jan. 1986 p 3-8 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

N87-16329*# United Kingdom Atomic Energy Authority, Risley (England). Space Tribology Lab.
TOWARDS AN OPTIMISED SPUTTERED MoS2 LUBRICANT FILM
E. W. Roberts *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 103-119 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 11G

N87-16750*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
CHARACTERIZATION OF ELASTOMERIC MATERIALS WITH APPLICATION TO DESIGN
Mark V. Bower *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer FAculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N87-16161# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNOLOGY EVALUATION (AT): METHODOLOGICAL STUDY AND ITS APPLICATIONS FOR A PRACTICAL CASE. PARTIAL EVALUATION OF COMBUSTIBLE ALCOHOL PRODUCTION M.S. Thesis [AVALIACAO DE TECNOLOGIA (AT): ESTUDO METODOLOGICO E SUA APLICACAO A UM CASO PRATICO - AVALIACAO PARCIAL DA PRODUCAO DE ALCOOL COMBUSTIVEL]
Maria Elenita Menezes Nascimento Sep. 1986 155 p In PORTUGUESE; ENGLISH summary
(INPE-3998-TDL/238) Avail: NTIS HC A08/MF A01

The purpose is to present current methodological approaches on Technology Assessment (AT) and a particular application: a partial technology assessment of fuel alcohol production considering environmental and production structure impacts. It is intended to study AT potentialities as methodology as analysis applied to situations where specific technology or sets of technologies play the major role. The applicability of AT on decision problem solving and the relationship between technology and public, political, and social aspects are exploited. Author

N87-16162# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
ANALYSIS AND MEASUREMENT OF HIGH FREQUENCY SOLID PROPELLANT RESPONSES Interim Report, 20 Sep. 1982 - 30 Oct. 1985
Michael M. Micci Jul. 1986 46 p
(Contract F04611-82-X-0063)
(AD-A172179; AFRPL-TR-86-010) Avail: NTIS HC A03/MF A01 CSCL 21/2

A program to study high frequency solid propellant responses is reported. The experimental techniques are based on the application of the magnetic flowmeter. A magnetic flowmeter burner was designed and constructed to evaluate the direct method of pressure-coupled response measurement. Response measurements were obtained for two formulations of AP/HTPB composite propellant at pressure oscillation frequencies from 4000 to 20,000 Hz. The measured data displayed consistent trends in both the real and imaginary parts of the pressure-coupled response function. The unsteady gas phase model of T'ien was used to predict response function trends as a function of frequency. The magnetic flowmeter techniques are currently being applied to the direct measurement of a solid propellant high frequency velocity-coupled response. GRA

N87-16163# Southwest Research Inst., San Antonio, Tex. Belvoir Fuels and Lubricants Research Facility.
SUMMARY OVERVIEW OF THE 2ND INTERNATIONAL CONFERENCE ON LONG-TERM STORAGE STABILITIES OF LIQUID FUELS
Leo L. Stavinoha Oct. 1986 41 p Conference held in San Antonio, Tex., 29 Jul. - 1 Aug. 1986
(Contracts DAAK70-85-C-0007; DA Proj. 1L7-62733-AH-20)
(AD-A174176; BFLRF-220) Avail: NTIS HC A03/MF A01 CSCL 21/4

Conference summaries include the following: Fuel Survey and Long-Term Storage Studies; Strategic and Emergency Fuel Storage; Operational Storage and Fuel Systems; Microbial Aspects of Fuel Stability; Biocides and Microbiology of Fuels; Methods for Characterization, Analysis and Testing; Theoretical Aspects of Fuel Stability; Test Method Development and Evaluation; Shale/Coal Liquids and Additive Chemistry; Effect of Refinery Processing and Additives on Stability. GRA

N87-16164# Army Research Office, Research Triangle Park, N.C.
COMBUSTION PROBES FOR SOLID NITRAMINES, WORKSHOP HELD IN LIVERMORE, CALIFORNIA ON 9-11 JUNE 1986
Robert W. Shaw, Jr., Sheridan C. Johnston, and George F. Adams Jun. 1986 272 p Workshop held in Livermore, Calif., 9-11 Jun. 1986
(AD-A174570) Avail: NTIS HC A12/MF A01 CSCL 19/1

The workshop emphasized the chemistry of nitramines, i.e., (1) the chemical species produced by the initial decomposition of nitramines, (2) reaction rates of those species likely to be important in nitramine combustion, (3) new methods for identifying and measuring concentrations of those species, especially in the condensed phase, and (4) theoretical calculations of potential energy surfaces for those species and their dynamics on those surfaces. GRA

N87-16165# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
EFFECT OF WEATHERING ON OCTANE QUALITY FOR WINTER-GRADE GASOLINES
R. N. Wares 31 Jul. 1986 32 p
(Contract DE-FC22-83FE-60149)
(DE86-014656; NIPER-178) Avail: NTIS HC A03/MF A01

The experimental program at NIPER was initiated to provide information to make technical judgments on fuel, fuel specifications, and fuel conditioning requirements for a range of fuels that could be utilized in current light aircraft. This portion of the work is centered on determining the acceptability of motor fuels that have been weathered, causing loss of volatile components. Commercial auto gasolines from various locations are being surveyed in terms of volatility and octane quality - in both as received and after weathering conditions. Antiknock quality is being evaluated to assess the suitability of this variety of auto fuels for aviation applications. To date, experiments have been conducted with ten winter (January to February) fuels that were obtained from commercial suppliers representing various geographic (refining) areas in the contiguous 48 states. The fuels were tested in as received condition with no modifications to the existing vapor pressures. Similar fuel properties (octane ratings, distillation character, fuel composition) are also presented in the section dealing with test results. DOE

N87-16166# Monsanto Research Corp., Miamisburg, Ohio.
LASER INITIATION OF TIH SUB x/KC10 SUB 4 (x = 0.2, 0.65, 1.65)
John A. Holy Jul. 1986 13 p
(Contract DE-AC04-76DP-00053)
(DE86-014700; MLM-3380(OP)) Avail: NTIS HC A02/MF A01

A laser initiation system for measuring the ignition properties of pyrotechnics and explosives is described. The laser source is a continuous wave (CW) argon laser operating in the visible wavelength region. A shutter-chopper system converts the CW beam to a pulsed beam. The 514.5 nm line with a chopped pulse width of 3 milliseconds was used to ignite the three pyrotechnic compositions TiH(x)/ClO4 (x = 0.2, 0.65, 1.65). In an argon atmosphere of 0.79 MPa, the ignition thresholds with a focused Gaussian beam diameter of 66 microns were 554, 866, and 657 microjoules for the three respective compositions. The ignition properties of TiH(x)/KClO4 are found to be strongly dependent on pressure. Rapid changes in the reflectivity of the sample surface also occur within microseconds after application of the laser pulse. DOE

N87-16182# Joint Publications Research Service, Arlington, Va.
COMBINED USE OF HYDROGEN AS FUEL ATOMIZER AND ADDITIONAL FUEL IN GAS-TURBINE ENGINE
P. M. Kanilo *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 2 Transl. into ENGLISH from Mashinovedeniye (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 113-115 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N87-16167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULATION OF FLUID FLOWS DURING GROWTH OF ORGANIC CRYSTALS IN MICROGRAVITY
Gary D. Roberts, James K. Sutter, R. Balasubramaniam, William K. Fowlis (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), M. D. Radcliffe (Minnesota Mining and Mfg. Co., St. Paul), and M. C. Drake 1987 11 p Prepared for presentation at the 32nd International SAMPE Symposium and Exhibition, Anaheim, Calif., 6-9 Apr. 1987
(NASA-TM-88921; E-3354; NAS 1.15:88921) Avail: NTIS HC A02/MF A01 CSCL 22A

Several counter diffusion type crystal growth experiments were conducted in space. Improvements in crystal size and quality are attributed to reduced natural convection in the microgravity environment. One series of experiments called DMOS (Diffusive Mixing of Organic Solutions) was designed and conducted by researchers at the 3M Corporation and flown by NASA on the space shuttle. Since only limited information about the mixing process is available from the space experiments, a series of ground based experiments was conducted to further investigate the fluid dynamics within the DMOS crystal growth cell. Solutions with density differences in the range of 10 to the -7 to 10 to the -4 power g/cc were used to simulate microgravity conditions. The small density differences were obtained by mixing D2O and H2O. Methylene blue dye was used to enhance flow visualization. The extent of mixing was measured photometrically using the 662 nm absorbance peak of the dye. Results indicate that extensive mixing by natural convection can occur even under microgravity conditions. This is qualitatively consistent with results of a simple scaling analysis. Quantitave results are in close agreement with ongoing computational modeling analysis. Author

N87-16168*# Clarkson Coll. of Technology, Potsdam, N.Y.
MODELLING DIRECTIONAL SOLIDIFICATION Semiannual Progress Report, 1 Mar. 1986 - 28 Feb. 1987
William R. Wilcox, Greg Neugebauer, Ross Gray, and Mohsen Banan 1987 10 p
(Grant NAG8-541)
(NASA-CR-180119; NAS 1.26:180119; SAPR-2; SAPR-3) Avail: NTIS HC A02/MF A01 CSCL 22A

The influence of convection and freezing rate fluctuations on compositional homogeneity and crystalline perfection was studied. B.G.

N87-16169# Pacific Northwest Labs., Richland, Wash.
TWO-PHASE ALKALI-METAL EXPERIMENTS IN REDUCED GRAVITY
Z. I. Antoniak Jun. 1986 69 p
(Contract DE-AC06-76RL-01830)
(DE86-012967; PNL-5906) Avail: NTIS HC A04/MF A01

Future space missions envision the use of large nuclear reactors utilizing either a single or a two-phase alkali-metal working fluid. The design and analysis of such reactors require state-of-the-art computer codes that can properly treat alkali-metal flow and heat transfer in a reduced-gravity environment. A literature search of relevant experiments in reduced gravity is reported on here, and reveals a paucity of data for such correlations. The few ongoing experiments in reduced gravity are noted. General plans are put forth for the reduced-gravity experiments which will have to be performed, at NASA facilities, with benign fluids. A similar situation exists regarding two-phase alkali-metal flow and heat transfer, even in normal gravity. Existing data are conflicting and in adequate for the task of modeling a space reactor using a two-phase alkali-metal coolant. The major features of past experiments are described here. Data from the reduced-gravity experiments with innocuous fluids are to be combined with normal gravity data from the

two-phase alkali-metal experiments. Analyses undertaken here give every expectation that the correlations developed from this data base will provide a valid representation of alkali-metal heat transfer and pressure drop in reduced gravity. DOE

N87-16775*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
COMPUTER-AIDED ANALYSIS FOR THE MECHANICS OF GRANULAR MATERIALS (MGM) EXPERIMENT
Joey K. Parker *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 24 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22A

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N87-16170 ESDU International Ltd., London (England).
SELECTION OF SURFACE TREATMENTS AND COATINGS FOR COMBATING WEAR OF LOAD-BEARING SURFACES
Nov. 1986 51 p
(ESDU-86040; ISBN-0-85679-592-5; ISSN-0141-2590) Avail: ESDU

This Data Item ESDU 86040 is an addition to the Tribology Sub-series. Guidance is given on the selection of treatments that include traditional techniques, such as carburizing and electroplating, and more recently developed methods, such as the chemical or physical vapor deposition processes and processes involving lasers or electron beams to alloy or remelt the surface layers. Selection of an appropriate treatment is aided by an appreciation of wear mechanisms and by an understanding of the mechanical requirements of the contacting surfaces. Accordingly, guidance is provided on those two topics. A selection procedure is developed supported by tabular information on the properties of the treated surfaces including such considerations as hardness, treatment temperature, depth of treatment and rate of application, corrosion resistance, and cost. A specification sheet is given for each type of treatment that summarizes salient features including surface preparation and final finish, damage risk, partial treatment of component, and size limitations. ESDU

N87-16171# Joint Publications Research Service, Arlington, Va.
USSR REPORT: ENGINEERING AND EQUIPMENT
13 Aug. 1986 74 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-86-007) Avail: NTIS HC A04/MF A01

Translated Russian articles from several publications concerning engineering and equipment are presented. The areas of interest are: Surface Transportation; Nuclear Energy; Construction; Industrial Technology; Turbine and Engine Design; High Energy Devices, Optics and Technology; and Testing and Materials. Some titles of interest are: Discovery doubles jet engine thrust in experiments; New camera based on laser radiation developed; Mathematical model of a fiber structure composite material; and Large area CdTe/Al2O3 epitaxial films. For individual titles, see N87-16172 through N87-16175.

N87-16172# Joint Publications Research Service, Arlington, Va.
DISCOVERY DOUBLES JET ENGINE THRUST IN EXPERIMENTS c07
In its USSR Report: Engineering and Equipment 13 Aug. 1986 p 58 Transl. into ENGLISH from Vechernyaya Moskva (Moscow, USSR), 20 Mar. 1986 p 1 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

A discovery in the field of mechanics is reported. The discovery increases the reactive force when atmospheric air is displaced by a fluctuating active jet. It is claimed that this phenomenon was previously unkown. The thrust horsepower of engines was increased by 2.0 to 2.5 times in experiments. This discovery makes it possible to heighten substantially the efficiency of jet engines, gas turbine units and other technology. E.R.

N87-16173# Joint Publications Research Service, Arlington, Va.
NEW CAMERA BASED ON LASER RADIATION DEVELOPED c35
In its USSR Report: Engineering and Equipment 13 Aug. 1986 p 59 Transl. into ENGLISH from Tass International Service (Moscow, USSR), 28 Feb. 1986 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

A film camera to register rapidly occurring processes in invisible ranges of laser radiation was created in the Moscow Scientific Research Institute of Optico-physical Measurements. The exposure takes micro seconds, the whole process of the laser flash is fixed on film, which is processed in the normal way, and the invisible becomes visible. The complex spatial structure of laser radiation forms a picture on the film. The film is put into a projector and the nature of laser radiation is studied. At the same time the instrument is able to give numerical values, which are entered into a computer. It is possible to control the work of lasers and to chose tuning of lasers used, for example, for unique eye operations or operations using a laser scapel. Author

N87-16174# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL MODEL OF A FIBER-STRUCTURE COMPOSITE MATERIAL c24
R. P. Mainya, I. N. Preobrazhenskiy, P. I. Preobrazhenskiy, and G. N. Khashba *In its* USSR Report: Engineering and Equipment 13 Aug. 1986 p 62 Transl. into ENGLISH from Soobshcheniya Akademii Nauk Gruzinskoy SSR (Tbilisi, USSR), v. 120, no. 3, 1985 p 501-504 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

A mathematical model of a fiber based composite material is presented, based on analysis of oriented reinforced composite materials as macroscopically homogeneous media consisting of a multitude of small diameter fibers uniformly distributed in a matrix. It is assumed that the model is to establish the interrelationship of the physical and mechanical characteristics of the composite materials as a function of the elastic characteristics of its components and their volumetric and spatial arrangement. The theory presented is based on elements of structural analysis and a superposition of the theory of unidirectional reinforced materials with the theory of elasticity of macroheterogeneous bodies. Initial assumptions include that the unidirectional reinforced material is a continuous macroscopically homogeneous monotropic, transversely isotropic body; the binding and reinforcing materials are linearly elastic, isotropic, and homogeneous; full bonding obtains between the materials; transversely directed stresses are negligible; and stresses in the binder and reinforcing materials are identical upon loading of the specimens transverse to the direction of the reinforcement. Author

N87-16175# Joint Publications Research Service, Arlington, Va.
LARGE-AREA CdTe/Al(SUB)2O(SUB)3 EPITAXIAL FILMS c76
E. A. Senokosev, K. D. Sushkevich, A. N. Usatyy, and V. M. Federov *In its* USSR Report: Engineering and Equipment 13 Aug. 1986 p 64-67 Transl. into ENGLISH from Izvestiya Akademii Nauk Moldavskoy SSR: Seriya Fiziko-Tekhnicheskikh i Matematicheskikh Nauk (Kishinev, USSR), no. 3, Sep. - Dec. 1985 p 67-69 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

In the group of A II B IV wide band gap semiconductor compounds, cadmium telluride is one of the most promising materials for converting solar energy into electricity. The wide practical use of CdTe for photoconverters has been restricted primarily by difficulties in growing high quality crystals with a large working surface area. The efficiency factor of polycrystalline film photocells does not exceed 5%. The search for and development of an effective technology for growing monocrystalline layers of CdTe having a large area with specified physical properties is one of the important directions in improving the operational characteristics of photocells. The production, study of the structure and

emissive properties of epitaxial n-CdTe/Al2O3 films with an area of approximately equal 20 sq cm is discussed. Films with a thickness of 10 to 50 microns, which were grown in a quasiclosed container under conditions close to thermal equilibrium, were investigated. n-CdTe crystals with a specific resistance of 100,000 to 1,000,000 ohms x cm were used for deposition. A correlation between the type and resistance of the films and the parent material was discovered. E.R.

N87-16176 Department of the Air Force, Washington, D.C.
HEATER BLOCK ASSEMBLY FOR USE IN THERMAL OXIDATION TESTING OF JET FUEL Patent
Robert A. Harvey, inventor (to Air Force) and Robert W. Morris, Jr., inventor (to Air Force) Issued 17 Jun. 1986 6 p Supersedes US-Patent-Appl-SN-651983
(AD-D012472; US-Patent-4,595,824; US-Patent-Appl-SN-651983; US-Patent-Class-219-302) Avail: US Patent and Trademark Office CSCL 21/4

This patent discloses a heater block assembly for a jet fuel test apparatus which has back and front plates with a test plate clamped inbetween. The test plate has a flat surface which faces the front plate, while the front plate has a raised ledge with a channel formed therein which faces the flat surface of the test plate. Inlet and outlet openings to opposite ends of the channel are formed through the front plate. When the back and front plates are clamped together with the test plate between, the flat surface of the test plate and the channel in the front plate together define a fuel sample flow passage. Thus, the fuel sample undergoing test is pumped through the inlet on the front plate into the flow passage where it flows along and in contact with the flat surface and out through the front plate. Electric heating rods in the back plate raise the temperature of the back plate and thereby the test plate and fuel sample, causing thermal decomposition deposits from the heated fuel to form on the flat surface of the test plate. GRA

N87-16177 Department of the Air Force, Washington, D.C.
FINE FIGURING ACTUATOR Patent
John W. Pepi, inventor (to Air Force) and Christopher M. Finch, inventor (to Air Force) Issued 22 Jul. 1986 4 p Supersedes US-Patent-Appl-SN-661833
(AD-D012476; US-Patent-4,601,553; US-Patent-Appl-SN-661833; US-Patent-Class-350-611) Avail: US Patent and Trademark Office CSCL 20/6

A novel mirror structure and actuator for precision control of the contour of a mirrored surface is described which comprises a movable control member for contacting the mirror faceplate, and a position controller, which may be in the form of an electrically controlled magnet and coil assembly, operatively interconnecting the control member and a rigid support for the mirror structure; a position sensor operatively interconnects the control member and the mirror support to sense the position of the control member and to provide a corresponding output signal; programmable information processing electronics, responsive to the output signal of the position sensor, provides an input signal to the position controller to move the control member against the faceplate whereby the shape of the faceplate may be controlled according to a preprogrammed scheme applied to the electronics. GRA

N87-16178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A REVIEW ON THE AVIATION PISTON ENGINE POWER ASSEMBLY FOR THE AIR CUSHION BOAT
Zhu Jianzhang 25 Sep. 1986 19 p Transl. into ENGLISH from Chuanbo Gongcheng (China), no. 5 1985 p 42-46
(AD-A172842; FTD-ID(RS)T-0765-86) Avail: NTIS HC A02/MF A01 CSCL 21/5

The aviation piston engine has a suitable power rating. The weight of the air cushion boat developed early was rather small, mostly ranging from 2 to 4 tons. The power rating of the air cushion boat is about 100 to 135 horsepower/ton. According to this, a single engine's power rating ranges from 200 to 500 horsepower. It is well known that this is exactly the most common power rating of an aviation piston engine (and an air-cooled diesel engine). GRA

N87-16179# Joint Publications Research Service, Arlington, Va.
USSR REPORT: ENGINEERING AND EQUIPMENT
24 Feb. 1986 126 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-86-003) Avail: NTIS HC A07/MF A01

Translated articles from different Russian publications are presented. The areas of interest covered are: Aeronautical and Space; Surface Transportation; Marine and Shipbuilding; Nuclear Energy; Industrial Technology; Turbine and Engine Design; Navigation and Guidance Systems; High Energy Devices, Optics and Photography; Fluid Mechanics; Mechanics of Solids; and Testing and Materials. For individual titles, see N87-16180 through N87-16185.

N87-16180# Joint Publications Research Service, Arlington, Va.
COST EFFECTIVENESS AND OPTIMAL PARAMETERS OF ROCKET ENGINE WITH ELECTRIC PROPULSION FOR SPACE SHUTTLE Abstract Only c20
D. D. Sevruk, V. K. Shinin, and A. F. Shtyrlin *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 1 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Aviatsionnaya Tekhnika (Kazan, USSR), no. 3, Jul. Sep. 1984 p 65-69 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

The cost effectiveness of electric propulsion in the shuttle stage of a rocket engine, moving the payload from lower orbit to higher orbit after the launch stage has moved it from ground to lower orbit, is compared with that of a liquid propellant shuttle. The evaluation is based on the mass balance in each case, in accordance with optimum design parameters for a typical flight program, considering that a liquid propellant shuttle requires a storage tank and feeders in addition to the power plant with energy converter. Numerical calculations indicate that the optimum power plant capacity for delivering a thrust of 3.2 to 5 N to a shuttle with initial mass of 30 t, with a specific pulse of 17 to 34 kN x s/kg and a life expectancy of (1-10) x 10,000 h, will be within the 70 to 83 kW range. Shuttling a payload into a geostationary orbit with oxyhydrogen liquid propellant costs roughly 4.500 U.S.$/kg, while using electric propulsion can reduce this cost by a factor of 1.5 to 3.2 for up to three flights. Author

N87-16181# Joint Publications Research Service, Arlington, Va.
TREATMENT OF TECHNICAL OBJECTS AS COMPLEX SYSTEMS
T. K. Sirazetdinov *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 1-2 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy: Aviatsionnaya Tekhnika (Kazan, USSR), no. 3, Jul. Sep. 1984 p 70-74 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

Formalization and automation of new design in modern technology requires the system approach to an object. The simplest treatment of a technical object as a single entity is not adequate for new developments in aircraft technology, neither is the next step of treating it as one made of indivisible interacting components with more than one possible realization. The approach must be extrapolated to treating a technical object as a complex system. In this way, the history of design analysis and synthesis becomes analogous to a trajectory in the phase space up to any point representing the present status. Problems of optimal design can be formulated on this basis, considering a problem may be a multitarget one and that a global extremum may be sought as a solution implied to be unique. As problems become more multivariant or multicriterial, or both, for objects operating in more than one mode, it becomes necessary to combine design and control of complex systems with appropriate simulation. The six basic methods of simulation for aircraft objects are: (1) as stochastic processes; (2) as sets or tubes defined mathematically by inequalities; (3) as sets of processes within the region of given motion describable by Liapunov functions; (4) with the mathematical

apparatus of diffuse spaces; (5) with the aid of a characteristic function and mathematical logic calculus including predicates; and (6) by programming on a computer in the language best suited for a given algorithm of solution. Author

N87-16182# Joint Publications Research Service, Arlington, Va.
COMBINED USE OF HYDROGEN AS FUEL ATOMIZER AND ADDITIONAL FUEL IN GAS-TURBINE ENGINE c28
P. M. Kanilo *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 2 Transl. into ENGLISH from Mashinovedeniye (Moscow, USSR), no. 1, Jan. - Feb. 1985 p 113-115 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

Use of hydrogen in gas turbine engines as gaseous agent for effective pneumomechanical atomization of liquid hydrocarbon fuel is considered, with the extra fuel this hydrogen provides as additional payoff. Analysis based on combustion thermodynamics and hydrodynamics, evaluation of mass balance and fuel economy, indicates significant advantages of such combined use of hydrogen typically during startup and low gas run. Calculations and numerical data applicable to gas turbine engines on YaK-40 and YaK-42 airplanes indicate, moreover, that such a use of hydrogen not only improves the combustion processes by facilitating its completion but also improves the engine reliability and lowers the toxicity level of exhaust emissions. Author

N87-16183# Joint Publications Research Service, Arlington, Va.
NUMERICAL ANALYSIS OF HEAT TRANSFER AT SURFACE OF DELTA WING IN HYPERSONIC AIR STREAM WITH LARGE ANGLE OF ATTACK c02
N. Ye. Afonina, A. Yu. Vlasov, and V. G. Gromov *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 74 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 196-199 Original language document was announced in IAA as A85-16190 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

An analysis is made of heat transfer for a delta wing with blunt edges and different catalytic properties of the surface in hypersonic flow at attack angles of 40 and 60 deg. Freestream Mach and Reynolds numbers are 24.1 and 0.85 x 10.000, respectively. The study employs a numerical model (using a conservative difference scheme) of the flow of a visious reactive gas in a shock layer at the windward side of blunt elongated bodies. The results indicate that the heterogeneous recombination of atoms has a significant effect on heat transfer. Author

N87-16184# Joint Publications Research Service, Arlington, Va.
SUPERSONIC MOTION OF BODIES IN GAS WITH SHOCK WAVES c32
V. F. Kamenetskiy and L. I. Turchak *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 75 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 141-147 Original language document was announced in IAA as A85-16179 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

Diffraction of a plane shock wave by a spherical or cylindrical body moving at supersonic velocity, with an attendant forward pressure jump, is treated as an axisymmetric problem with two basic variants: (1) body and shock wave coming from opposite directions, with the shock wave moving at a higher velocity; and (2) body and shock wave moving in the same direction, with the body coming from behind at a higher velocity. The problem conditions are in each case completely defined by the Mach number of the body and the Mach number of the shock wave, both referred to the acoustic velocity in the oncoming gas stream without shock wave. The gas is assumed to be ideal with the ratio of specific heats k = 1.4 (air) in all regions. One part of the problem is to determine the Mach number in the region behind the shock wave, in which the body continues to move in each case after the impact, the Mach number here being always higher that that of the shock wave. The remaining part of the problem is solving the system of Euler equations which describes transient flow of a nonviscous and nonconducting gas for appropriate initial and boundary conditions, with acoustic velocity and entropy as the independent thermodynamic variables. Author

N87-16185# Joint Publications Research Service, Arlington, Va.
TURBULENT BOUNDARY LAYER AT MOVING SURFACE OF CYLINDRICAL BODY c34
V. M. Zubarev *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 75-76 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 61-67 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

An analysis is made of the two dimensional turbulent boundary on the moving surface of a cylindrical body (a Rankine oval with an aspect ratio of 4) moving at constant velocity in an incompressible fluid. A numerical simulation is used in which the boundary layer is divided in accordance with a two layer model into inner and outer regions, for which different expressions for the turbulent transport coefficients are employed. The following integral characteristics are determined for the body: the work of the friction force as the body moves; the work expended on the motion of its surface; and (for separated flow) the work of the pressure force. These characteristics are compared with corresponding integral characteristics obtained for laminar flow, on the moving surface of a flat plate, and on a wing of infinite span whose contour is a Rankine oval. Author

N87-16186# Joint Publications Research Service, Arlington, Va.
USSR REPORT: ENGINEERING AND EQUIPMENT
26 Aug. 1986 96 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-86-008) Avail: NTIS HC A05/MF A01

Topics addressed include: aeronautics and space; nuclear energy; non-nuclear energy; marine technology; shipbuilding; construction; industrial technology; turbine and engine design; navigation and guidance; high energy devices; optics and photography; fluid mechanics; mechanics of solids; and materials testing. For individual titles, see N87-16187 through N87-16192.

N87-16187# Joint Publications Research Service, Arlington, Va.
OPTIMUM BEARING SURFACES OF WINGS WITH INTRICATE GEOMETRY FOR SUPERSONIC FLIGHT Abstract Only c05
Ye. M. Prokhorov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 1 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 154-160 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

The bearing surface of a wing for supersonic flight is optimized with respect to minimum strain and pitch. The optimum shape of this surface is sought in the class of piecewise-constant functions describing it. The problem is solved so as to satisfy all constraints of the linear theory and with a high degree of smoothness. Use of two computational grids shifted from one another eliminates the need for smoothing the resistance coefficients fo drag and lift. Calculations were made for a delta wing with 76 to 57 degree broken-line front edges in the plane view, the target being to ensure nonseparation flow and zero load on the subsonic front edges at the supersonic velocity N sub M = 2. Author

N87-16188# Joint Publications Research Service, Arlington, Va.
ROTATION OF SOLID BODY IN MAGNETIC FIELD c70
V. V. Kozlov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 44 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 28-33 Original language document was announced in IAA as A86-24283 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

The rotation of a ferromagnetic body in a homogeneous magnetic field that remains constant in time was examined. In

particular, attention is given to the integrability of the equations of motion and to the existence of periodic rotations of the rigid body. In the case where the magnetic moment of the body generated in accordance with the Barnett effect is proportional to the vector of the angular speed of the body, a relationship is established between the problem considered here and the problem of the motion of a rigid body in an ideal fluid. IAA

N87-16189# Joint Publications Research Service, Arlington, Va.
NONLINEAR INTEGRO-DIFFERENTIAL EQUATIONS FOR AEROELASTICITY c05
I. S. Astapov, A. S. Belotserkovskiy, and V. I. Morozov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 44-45 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverkogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 61-70 Original language document was announced in IAA as A86-24287 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

Nonlinear integro-differential nonstationary aeroelasticity equations are obtained for the general case of the three-dimensional motion of an elastic flight vehicle with loads in a nonstationary gas flow. Cauchy formulas for the Volterra integro-differential equations, unresolved with respect to the derivative, are presented. The formulas presented here are used for analyzing the stability, in the sense of Liapunov, of solutions to the integro-differential nonstationary aeroelasticity equations in the case where the integral kernels are replaced by approximation functions, with allowance made for the nonlinearity and motion parameters that are explicitly time-dependent. IAA

N87-16190# Joint Publications Research Service, Arlington, Va.
MOTION OF GYROSCOPE WITH LOW SELF-EXCITATION c35
M. L. Pivovarov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 45 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 23-27 Original language document was announced in IAA as A86-24282 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

The evolution of the motion of a self-excited gyroscope is analyzed for the case where the perturbation moment contains terms that depend quadrically on the angular speed. The study is relevant to the problem of sustaining the angular speed of a gyroscope by means of a moment proportional to the difference of the squares of the actual and required angular speeds in the case where the moment is small in comparison with the kinetic energy of rotation. IAA

N87-16191# Joint Publications Research Service, Arlington, Va.
ACCELERATION OF CONTACTLESS GYROSCOPE IN RESISTANT MEDIUM c35
S. F. Kudin and Yu. G. Martynenko *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 46 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 14-22 Original language document was announced in IAA as A86-24281 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

An analysis is made of the motion of a symmetric rigid body about its center of mass in a resistant medium, with an active torque sustaining a constant angular speed of rotation. The moment of resistance is assumed to be a linear function of the angular speed of the body, and the active moment is generated due to the effect of a rotating magnetic field applied to a conductor. The rotating magnetic field is produced by the drive system of the gyroscope rotor, as in the case of the stator of an asynchronous motor. Stability conditions for the stationary rotation of the gyroscope are obtained both in the nonresonance case and in the resonance case, where the nutation frequency of the rotor is equal to the angular speed of the field. IAA

N87-16192# Joint Publications Research Service, Arlington, Va.
INTEGRATION OF EQUATIONS OF MOTION OF GYROCOMPASS c35
R. Kh. Bashirov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 46-47 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 3-13 Original language document was announced in IAA as A86-24280 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

Complete nonlinear equations of motion for a gyrocompass with a gimball suspension of the sensitive element are integrated asymptotically, with allowance made for the inertia moments of the gimball frames in addition to the finite nature of the rotation angles. It is shown that, as in the case of approximate equations, the solution to the exact equations is conditionally periodic. The slow oscillation periods of the gyrocompass are expressed in the form of Legendre elliptic integrals. IAA

N87-16193# Joint Publications Research Service, Arlington, Va.
JAPAN REPORT: SCIENCE AND TECHNOLOGY
17 Nov. 1986 111 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-86-034) Avail: NTIS HC A06/MF A01

Articles from several Japanese publications are translated. Most of the articles concern new materials. Some representative titles are: Arrival of titanium age, future applications discussed; Recent trends in ceramic solid state devices; Electromagnetic shield materials discussed. For individual titles, see N87-16194 through N87-16196.

N87-16194# Joint Publications Research Service, Arlington, Va.
ARRIVAL OF TITANIUM AGE, FUTURE APPLICATIONS DISCUSSED c26
Takashi Muro *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 64-69 Transl. into ENGLISH from Nikko Materials (Tokyo, Japan), Jan. 1986 p 13-16 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

The research, development, and industrialization of titanium alloy has been carried out rapidly. Titanium is lightweight, resistant to rust and heat, and has high strength. Japan stands second in the world as a producer of sponge titanium, a raw material of titanium. With regard to putting this alloy to practical use, however, Japan has been outpaced by the West because it has not been profitable for Japanese material manufacturers to invest in research and development. In addition, these manufacturers have not had the demand for metallic materials for aircraft and space. At present, however, steel, nonferrous, titanium, metallic processing, and rolling manufacturers are waiting for an opportunity to branch into high grade field materials by successively investing in the development of titanium alloy or starting the industrialization of the metal, as a result of these manufacturers being influenced by the needs of the high technology oriented industrial world. It is anticipated that demand, except in the aircraft field, will be increased greatly in the 21st century, if function and potential are clarified successively. Author

N87-16195# Joint Publications Research Service, Arlington, Va.
RECENT TRENDS IN CERAMIC SOLID STATE DEVICES c27
Noboru Ichinose *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 70-79 Transl. into ENGLISH from Ceramics Japan (Tokyo, Japan), Jan. 1986 p 3-8 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

Research and development of electronic materials is the basis for advancement in the electronics industry. It is an urgent necessity that Japan carry out independent research and development on new electronic materials technology, and use the results in device making. Devices related to microelectronics, optoelectronics, displays, sensors, and mechatronics are discussed as ceramic solid state devices. Toward the 21st centruy, the appearance of new devices that make active use of ceramics should be expected. Author

N87-16196# Joint Publications Research Service, Arlington, Va.
ELECTROMAGNETIC SHIELD MATERIALS DISCUSSED c32
Masaya Kurata *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 80-87 Transl. into ENGLISH from Nikko Materials (Tokyo, Japan), Apr. 1986 p 89-96 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

Electromagnetic wave shield materials have been developed over the past several years. The opinion that using steel boxes would cause no problems has changed to the opinion that using metal boxes would cause no problems. Clearly, if computers are stored in metal boxes, these computers will avoid electromagnetic interference. Many electromagnetic wave shield materials have been devised, developed, and put into practical use. These materials are briefly discussed. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N87-16197 ESDU International Ltd., London (England).
AN INTRODUCTION TO THE Z-TRANSFORM AND ITS APPLICATION TO SAMPLED-DATA SYSTEMS
Dec. 1986 31 p
(ESDU-86037; ISBN-0-85679-589-5; ISSN-0141-3988) Avail: ESDU

This Data Item ESDU 86037 is an addition to the Dynamics Sub-series. The representation of a continuous signal by a sequence of equally spaced pulses each of which provides the value of the continuous signal at the particular sampling instant is introduced. The relationship of such a sequence to the Z-transform is established, and properties of the transform are given. The Z-transform is related to the Laplace transform and the relationships between poles and zeroes in the complex s-plane to those in the complex z-plane are provided. Using the Z-transform the relationship between the sampled input and output of a system element, the pulse transfer function, is found and the method of combining such functions for individual elements to obtain a pulse transfer function, is found and the method of combining such functions for individual elements of cascaded elements in open or closed loop form is illustrated. The delayed Z-transform and multirate sampling, which allow signal information to be obtained between sampling instants, are described. The use of data hold filters for reconstitution of the continuous signal is explained, and methods of obtaining the original sampled signal by inverting the Z-transform are given and illustrated. ESDU

N87-16198*# Ohio State Univ., Columbus. ElectroScience Lab.
ENGINEERING CALCULATIONS FOR COMMUNICATIONS SATELLITE SYSTEMS PLANNING Interim Report, 15 Jan. - 11 Jul. 1986
C. H. Reilly, C. A. Levis, O. M. Buyukdura, and C. A. Mount-Campbell
Nov. 1986 21 p
(Grant NAG3-159)
(NASA-CR-180106; NAS 1.26:180106; TR-718688-1) Avail: NTIS HC A02/MF A01 CSCL 17B

Observed solution times were analyzed for the extended gradient and cyclic coordinate search procedures. The times used in the analysis come from computer runs made during a previously-reported experiment conducted to assess the quality of the solutions to a BSS synthesis problem found by the two search methods. The results of a second experiment with a Fixed Satellite Service (FSS) test problem are also presented. Computational results are summarized for mixed integer programming approaches for solving FSS synthesis problems. A promising heuristic algorithm is described. A synthesis model is discussed for orbital arc allotment optimization. Research plans for the near future are also presented. Author

N87-16199# Department of the Air Force, Washington, D.C.
REFLECTOR ANTENNA HAVING SIDELOBE NULLING ASSEMBLY Patent Application
J. L. Poirier, inventor (to Air Force) Filed 4 Jun. 1986 16 p
(AD-D012440; US-Patent-Appl-SN-870562) Avail: NTIS HC A02/MF A01 CSCL 09/5

A reflector antenna having an adaptive nulling assembly is described. The assembly comprises a disk shaped mounting plate having a shaft aligned with the rotational axis thereof and passing through the main reflector focusing surface. An absorber of electromagnetic energy is affixed to the disk and a microwave grating of metallic elements is positioned on the surface of the absorber. The amplitude of the nulling signal is controlled by rotating the assembly, and the phase of the nulling signal is controlled by the varying height of the grating above the reflector. Additional nulling elements can be used to null multiple interference sources. Author (GRA)

N87-16200# Rome Air Development Center, Griffiss AFB, N.Y.
A TRANSPORTABLE VLF/LF REPEATER TERMINAL: A DESIGN STUDY
Donald G. Iram Jul. 1986 52 p
(AD-A171780; RADC-TR-86-86) Avail: NTIS HC A04/MF A01 CSCL 17/2

The design of a transportable, rapidly erectable VLF/LF repeater terminal is considered. Operational parameters bound the performance requirements. The total system must be transportable on standard vehicles over hard surface roads. The system must be erected and operated within a nominal 8-hour day. Each subsystem must be composed of available hardware and existing (proven) technology. The terminal must also radiate 5 DW at 36 KHz. The system performance criteria are used to define the system design. These are translated into the design of the subsystems. Alternative implementations to satisfy each design are explored. The most satisfactory implementation is obtained by an elimination process. Once an operational system design is achieved, the problem of demonstrating the feasibility of that design using existing experimental assets, inventory hardware and manufactured components is addressed. The design of a demonstration system results from this second level analysis.
Author (GRA)

N87-16201# Naval Research Lab., Washington, D. C.
MILSTAR/FEP (FLTSATCOM EHF PACKAGE) EMPHEMERIS PACKAGE Memorandum Report, Sep. 1984 - Sep. 1985
Robert R. Dasenbrock and William H. Harr 15 Aug. 1986 69 p
(AD-A171829; NRL-MR-5823) Avail: NTIS HC A04/MF A01 CSCL 22/3

Design constraints require that as Earth terminal attempting communications with a FLTSATCOM EHF Package (FEP) located onboard a FLTSATCOM satellite be provided with an accurate FEP package. To be precise, the terminal is provided with a coefficient element set from which the ephemeris of a satellite may be computed. This report describes the operation of a user friendly computer program that produces the above mentioned coefficient set so as to provide reference benchmarks from which the ephemeris related operations of the terminal can be judged.
GRA

N87-16202 Department of the Air Force, Washington, D.C.
FREQUENCY SELECTIVE SIGNAL-TO-NOISE ENHANCER/LIMITER APPARATUS Patent
Steven N. Stitzer, inventor (to Air Force), Harry Goldie, inventor (to Air Force), and Fritzi Goldie, inventor (to Air Force) Issued 17 Jun. 1986 5 p Supersedes US-Patent-Appl-SN-675171
(AD-D012473; US-Patent-4,595,889; US-Patent-Appl-SN-675171; US-Patent-Class-338-17) Avail: US Patent and Trademark Office CSCL 09/5

The signal-to-noise enhancer can be used in frequency

memory loops to prevent loop capture by noise. If a frequency selective limiter is incorporated in the loop, more than one signal can be stored simultaneously because the limiter prevents the loop amplifier from saturating. At present, the limiter must be a separate device. The frequency selective signal-to-noise enhancer/limiter apparatus comprises an enhancer apparatus and a limiter apparatus on a single substrate, using a single pair of magnets to bias both units. GRA

N87-16203 Department of the Air Force, Washington, D.C.
PHASE ONLY ADAPTIVE NULLING IN A MONOPULSE ANTENNA Patent
Randy L. Haupt, inventor (to Air Force) Issued 8 Jul. 1986 16 p Supersedes US-Patent-Appl-SN-629926
(AD-D012516; US-Patent-4,599,622; US-Patent-Appl-SN-629926; US-Patent-Class-343-427) Avail: US Patent and Trademark Office CSCL 17/9

A monopulse radar having a single set of phase shifters shared by both sum and difference channels is described. The radar utilizes an algorithm that effects simultaneous nulling in the sum and difference patterns of its phased array antenna. An algorithm is developed for phase-only nulling which does not require knowledge of the location of interference sources. Author (GRA)

N87-16204# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
RADAR REFLECTIVITY Final Report
10 Jul. 1986 12 p Supersedes MTP-7-3-524
(AD-A173508; TOP-7-3-524; MTP-7-3-524) Avail: NTIS HC A02/MF A01 CSCL 17/9

This TOP describes a method for measuring the radar reflectivity characteristics of aircraft. It uses a rotating platform and various radar systems to obtain calibrated radar Automatic Gain Control values for each degree of aspect angle for the aircraft. The purpose of this test is to provide comparable values of radar reflectivity for Army aircraft at various radar frequencies and parameter for fixed positions and aspect angles on the aircraft. Data collected on each specific aircraft can be used to evaluate radar reflectivity characteristics of aircraft skin material, paint, and structural changes such as flat versus curved surfaces. GRA

N87-16205# Wisconsin Univ., Madison. Mathematics Research Center.
MINIMIZING THE REFLECTION OF ELECTROMAGNETIC WAVES BY SURFACE IMPEDANCE Technical Summary Report
T. J. Bridges, G. Chen (Pennsylvania State Univ., University Park), and G. Crosta (Milan Univ., Italy) Jul. 1986 35 p
(Contract DAAG29-80-C-0041; Grants NSF DMS-82-10950; NSF MCS-78-22830; NSF DMS-84-01297)
(AD-A172585; MRC-TSR-2942) Avail: NTIS HC A03/MF A01 CSCL 20/14

In an empty halfspace a point source emits electromagnetic waves of fixed frequency and arbitrary polarization. The fields reflected by an imperfectly conducting plane, characterized by a constant, isotropic surface impedance, are determined by means of the geometrical optics approximation. An optimization method is used to compute the surface impedance, which minimizes a given function of the e.m. fields (e.g. the average energy density) at a given observation point. The properties of the functions to be minimized are studied and a set of numerical results is presented and discussed. GRA

N87-16206# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A HIGH FREQUENCY ANALYSIS OF ELECTROMAGNETIC PLANE WAVE SCATTERING BY A FULLY ILLUMINATED PERFECTLY CONDUCTING SEMI-INFINITE CONE Ph.D. Thesis
Keith D. Trott 1986 130 p
(AD-A172838; AFIT/CI/NR-86-186D) Avail: NTIS HC A07/MF A01 CSCL 20/6

A uniform high frequency asymptotic solution, based upon the physical optics (PO) approximation, is obtained in the format of the uniform theory of diffraction (UTD) to describe the field diffracted by the tip of a semiinfinite, perfectly conducting cone when it is fully illuminated by an electromagnetic plane wave. The solution is expressed in terms of an integral, over finite limits, which can be numerically integrated without difficulty. The solution is uniform in the sense that, unlike the previous solution based upon PO which is valid only on the deep shadow side of the reflection boundary, and becomes singular at the reflection boundary, the present solution remains bounded and continuous within the transition region adjacent to the reflection boundary. Outside the transition region, the various field terms in the integral form of the solution can be interpreted in terms of the geometrical theory of diffraction (GTD) as being associated with the total field consisting of the incident, surface reflected, and tip diffracted ray fields. It is noted that the PO approximation is based upon the use of the geometrical optics (GO) current on the cone. A correction to the PO tip diffracted field is investigated based on the behavior of the exact eigenfunction expansion near the tip; this problem needs further study. The results computed from just the uniform asymptotic PO solution compare well with previously published results for narrow angle semiinfinite cones. Author

N87-16207# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE EFFECT OF SYSTEM DEPOLARIZATION ON MEASUREMENT QUALITY M.S. Thesis
Robert J. Nelson May 1986 125 p
(AD-A172917; AFIT/CI/NR-86-177T) Avail: NTIS HC A06/MF A01 CSCL 17/9

Radar systems are susceptible to depolarization effects caused by the system and the environment. System effects include depolarization caused by antennas and measurement configurations. Antenna effects arise from the assumption that the cross polarization isolation response is infinite across the beamwidth of the antenna. In fact, the isolation response can be as high as -20 dB at boresight to 0 dB 2-3 degrees off-axis. Depolarization due to measurement configurations comes from the translation necessary to match the antenna coordinate system to the clutter coordinate frame. For large beamwidths at small angles of incidence this translation can cause significant depolarization. These phenomena have been investigated separately in the monostatic case. This research extends previous work done in the monostatic case to the bistatic case. A computer simulation was developed which models a bistatic clutter environment. The simulation models depolarization sources caused by system and surface effects. GRA

N87-16208# Naval Ocean Systems Center, San Diego, Calif.
NEAR-WATER PROPAGATION EFFECTS AND MODERN SYSTEMS ADAPTATIONS
J. H. Richter Jul. 1986 40 p
(AD-A173606; NOSC/TD-973) Avail: NTIS HC A03/MF A01 CSCL 20/14

The Electromagnetic Wave Propagation Panel (EPP) of AGARD (Advisor Group for Aerospace Reseach and Development for NATO) has established a working group with the objective of assessing the effects of electromagnetic wave propagation along water surfaces for the entire electromagnetic spectrum from very low frequencies up to those in optical ranges. The working group is examining normal and abnormal propagation conditions with the aim of optimizing the performance of modern systems in communications, surveillance, and navigation, with special attention devoted to adaptive measures. This document is the author's contribution to the AGARD report covering the frequency range from 30 MHz to 300GHz. GRA

N87-16209# Florida Univ., Gainesville.
ELECTROMAGNETIC SCATTERING FROM A HELIX Contractor Report, Aug. - Dec. 1985
Ru T. Wang Sep. 1986 16 p
(Contract DAAG29-81-D-0100)
(AD-A173608; CRDEC-CR-86071) Avail: NTIS HC A02/MF A01 CSCL 20/14

Microwave measurements of scattering by a helix made from

an acrylic rod are reported. All measurement results on extinction (0 = 0 deg) and angular scattering (10 deg less than or equal to theta (10 deg) less than or equal to 170 deg) are given in absolute magnitude and are displayed in comprehensive graphical form. Emphasis on measurements/discussions is based on 3 principal orientations of the helix in the beam; i.e., with the helical axis parallel to the incident k, E, and H vectors. Analysis is based primarily on the accuracy of the data, comparisons to scattering by an equal-volume sphere, and some of the outstanding features noted from this experiment. GRA

N87-16210# Environmental Research Inst. of Michigan, Ann Arbor.
INTEGRATION AND DEMONSTRATION OF THE STAR-1 RADAR SYSTEM WITH A REAL TIME SOFT COPY DISPLAY Final Report
P. Lumley, W. Wolters, B. Buchholz, H. McKenney, and R. Motyka Jul. 1986 74 p
(Contract DAAK20-84-C-0892)
(AD-A173746; ERIM-178000-17-F) Avail: NTIS HC A04/MF A01 CSCL 17/9

This report describes three basic tasks. The first task is the definition and implementation of a real-time softcopy display to be used with STAR-1 real-time synthetic aperture radar system. The second task was the all-up system demonstration of the STAR-1, together with the real-time softcopy display. The third task is a data collection for targets of Army interest using the STAR-1 in conjunction with the softcopy display defined and implemented in the first task. Author (GRA)

N87-16211# Rome Air Development Center, Griffiss AFB, N.Y.
POLAR AZIMUTH DIVERSITY HF PROPAGATION EXPERIMENT
Kurt A. Baker, D. M. Haines, and Bertus Weijers Mar. 1986 52 p
(AD-A174157; RADC-TR-86-11) Avail: NTIS HC A04/MF A01 CSCL 17/2

Presented are the results of an HF Azimuth Diversity Propagation Experiment conducted by RADC over several paths, trans-auroral and polar, separated in azimuth by 30, 70, and 100 degrees, as part of the RADC Adaptive HF Propagation Program. The data presented give the occurrence of several ionospheric characteristics important to the operation of HF networks in a disturbed environment. The analysis was performed on data collected during the four seasonal periods to obtain statistical samples representative of each season under slightly disturbed as well as quiet conditions. The system used to collect the data was a network of three chirpsounder transmitters and one receiver, each sweeping over a frequency range of 2 to 30 MHz, once every five minutes. The transmitters were located at Ava, N.Y., Grand Forks, N. Dak., and Barter Island, Alaska. The receiving system was located at Thule Air Base, Greenland. GRA

N87-16212# Texas Univ., Austin. Microwave Lab.
HIGH-SPEED PULSE TRANSMISSION ALONG A SLOW-WAVE CPW FOR MONOLITHIC MICROWAVE INTEGRATED CIRCUITS
Ching-Kuang C. Tzuang and Tatsuo Itoh 19 Sep. 1986 50 p
(Contract N00014-79-C-0553)
(AD-A174271; MW-86-P-3) Avail: NTIS HC A03/MF A01 CSCL 09/5

Very high-speed picosecond range pulse transmission along a coplanar wave guide (CPW) integrated in a monolithic microwave integrated circuit (MMIC) is analyzed in the time domain, changing the input excitations, conductivity of the epitaxial layer, and terminating conditions. The time domain waveform is obtained by inverse discrete Fourier transform (IDFT) of the frequency domain data, namely, complex characteristic impedance and propagation constant. The full wave mode-matching method (MMM) is employed to analyze the dispersion of the CPW. A simple wide band matching scheme is found to be effective to make the slow-wave CPW a viable circuit element in applications such as a delay line or an interconnection line. Knowing the device processing data and physical dimensions, a designer should benefit from the present analysis that simulates the transmission of a very high-speed pulse on an MMIC CPW under various terminations. GRA

N87-16213# Pennsylvania Univ., Philadelphia. School of Electrical Engineering.
CONFORMAL MICROSTRIP SLOT ANTENNA AND ANTENNA ARRAY Interim Report, Mar. 1985 - Feb. 1986
Moshe Kisliuk, Bernard Steinberg, and William Whistler Sep. 1986 46 p
(Contract F19628-84-K-0021)
(AD-A174370; RADC-TR-86-0114) Avail: NTIS HC A03/MF A01 CSCL 09/5

This study explores the wideband potential of a microstrip-fed slot radiator as an element of a planar or conformal antenna array. The microstrip slot is seen to have 40% input impedance bandwidth under 1.5 BSWR and a demonstrated 10% gain bandwidth to 3db. The report describes an analytic slot model and experimental tests. A conclusion of this report is that useful high efficiency radiators (greater than 80%) can be made by using the microstrip slot in N-element serial arrays. GRA

N87-16214# Lawrence Livermore National Lab., Calif.
EXPERIMENTAL DATA FOR EM COUPLING THROUGH SLOTS
R. J. King and H. G. Hudson Jul. 1986 129 p
(Contract W-7405-eng-48)
(DE86-015011; UCID-20842) Avail: NTIS HC A07/MF A01

A key factor in predicting the vulnerability of military systems to a wide variety of electromagnetic threats involves understanding the phenomenology of how the energy penetrates through back door ports of entry (POE's). The first part of this report focuses on broadband (0.1 + 18 GHz) laboratories and measurement techniques being used in such studies. The emphasis is on coherent CW experiments because of the very great sensitivity, dynamic range, accuracy, flexibility, and data acquisition/processing capabilities of modern RF instrumentation systems. Experimental data are given for several slot/crack configurations in a metal wall; simple slots and covered slots in a thin wall, deep slots and grooved slots in a thick wall, and dielectrically loaded slots. Also included are comparisons of slotted-wall data with cavity-backed slotted-wall data. Limited comparisons are made with experimental and analysis/numerically modeled data. Attention is focused near and above the frequency ranges where the slots are resonant. Explanations of the associated coupling phenomenologies are given for each case. DOE

N87-16215# California Univ., Davis. Signal and Image Processing Lab.
REPRESENTATION AND COMPRESSION OF FACSIMILE AND GRAPHICS DATA
P. L. Kelly and V. R. Algazi Aug. 1986 33 p
(Contract W-7405-eng-48)
(DE87-001312; UCRL-15834) Avail: NTIS HC A03/MF A01

Digital transmission and storage of facsimile images became a topic of active research and commercial interest in the mid 1970's. Goal of our research is to establish a framework for modeling facsimile data and then use this framework to more efficiently represent facsimile images while maintaining or improving quality. In this report we limit our focus to three aspects of our proposed framework, namely preprocessing, global modeling, and signal representation. We also briefly review current models for facsimile images. DOE

N87-16216# National Bureau of Standards, Boulder, Colo. Center for Electronics and Electrical Engineering.
STUDY OF TECHNIQUES FOR MEASURING THE ELECTROMAGNETIC SHIELDING EFFECTIVENESS OF MATERIALS
P. F. Wilson and M. T. Ma May 1986 72 p Sponsored by Army Aviation Systems Command
(PB86-244183; NBS-TN-1095) Avail: NTIS HC A04/MF A01; also available SOD HC $3.50 as 003-003-02735-9 CSCL 14B

A number of measurement approaches are studied, including the use of an electromagnetically shielded room, coaxial transmission line holders, time domain signals, the dual TEM cell, and an

apertured TEM cell in a reverberation chamber. In each case the system's frequency range, test sample requirements, test field type, dynamic range, time required, analytical background, and present data taken on a common set of materials are considered. GRA

N87-16217# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
ELECTROMAGNETIC COMPATIBILITY AND INTERFERENCE METROLOGY
M. T. Ma and M. Kanda Jul. 1986 180 p
(PB87-102489; NBS-TN-1099) Avail: NTIS HC A09/MF A01; also available SOD HC $8.50 as 003-003-02760-0 CSCL 09C

The material included in the report is intended for a short course on electromagnetic compatibility/interference (EMC/EM) metrology. The entire course is presented in nine chapters with the introductory part given as Chapter 1. The particular measurement topics to be covered are: (1) open sites (Chapters 2 and 6), (2) transverse electromagnetic cells (Chapter 3), (3) techniques for measuring the electromagnetic shielding of materials (Chapter 4), (4) anechoic chambers (Chapter 5), and (5) reverberating chambers (Chapter 8). In addition, since small probe antennas play an important role in some of the EMC/EMI measurements discussed, a separate chapter on various probe systems developed at NBS is given in Chapter 7. Selected contemporary EMI topics such as the characterization and measurement of a complex EM environment, interferences in the form of out-of-band receptions to an antenna, and some conducted EMI problems are also briefly discussed (Chapter 9). GRA

N87-16022*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF THE LENS ANTENNA DEPLOYMENT DEMONSTRATION (LADD) SHUTTLE-ATTACHED FLIGHT EXPERIMENT
H. Hill, D. Johnston, and H. Frauenberger (Grumman Aerospace Corp., Bethpage, N.Y.) *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 125-144 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20N

N87-16023*# Martin Marietta Aerospace, Denver, Colo.
BOX TRUSS ANTENNA TECHNOLOGY STATUS
J. V. Coyner and E. E. Bachtell *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 145-148 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20N

N87-16025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 15 METER HOOP-COLUMN ANTENNA DYNAMICS: TEST AND ANALYSIS
W. Keith Belvin and Harold H. Edighoffer (Edighoffer, Inc., Newport News, Va.) *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 167-185 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20N

N87-16028*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 1: BEAM DYNAMICS AND CONTROL TECHNOLOGY OVERVIEW
John L. Allen *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 221-232 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20N

N87-16184# Joint Publications Research Service, Arlington, Va.
SUPERSONIC MOTION OF BODIES IN GAS WITH SHOCK WAVES
V. F. Kamenetskiy and L. I. Turchak *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 75 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 141-147 Original language document was announced in IAA as A85-16179 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

N87-16196# Joint Publications Research Service, Arlington, Va.
ELECTROMAGNETIC SHIELD MATERIALS DISCUSSED
Masaya Kurata *In its* Japan report: Science and Technology (JPRS-JST-86-034) 17 Nov. 1986 p 80-87 Transl. into ENGLISH from Nikko Materials (Tokyo, Japan), Apr. 1986 p 89-96 (For primary document see N87-16193 08-31)
Avail: NTIS HC A06/MF A01

N87-16772*# Berry Coll., Mount Berry, Ga. Dept. of Physics.
A STUDY OF RADAR CROSS SECTION MEASUREMENT TECHNIQUES
Malcolm W. McDonald *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 22 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 17I

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N87-16218# California Univ., Berkeley. Dept. of Electrical Engineering.
RESEARCH IN VLSI RELIABILITY Annual Report, 1 Aug. 1985 - 31 Jul. 1986
Chenming Hu and Nathan Cheung 31 Jul. 1986 4 p
(Contract N00014-85-K-0603)
(AD-A171704) Avail: NTIS HC A02/MF A01 CSCL 09/5

In order to increase the circuit density and speed of VLSI systems, microelectronic device geometry is shrinking from a few microns to submicron and beyond. This scaling has greatly heightened the need for a better understanding of the failure mechanisms affecting the long-term reliability of VLSI system and for improved methods of designing and testing for reliability. In contrast to production technologies and circuit performances, whose failures to meet specifications will be either obvious or relatively easily discovered before the circuits are incorporated into complex systems or missions, reliability failures cannot be easily or completely eliminated. When they do occur, reliability failures can be costly in many ways. The objective of this research is to gain basic scientific understanding of the mechanisms of the three leading hard failure modes: oxide wearout, hot-electron-induced degradations, and contact and metal failures. The basic understanding should lead to failure models and methods to improve reliability assurance through design, processing, and testing techniques. Author (GRA)

N87-16219# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Sciences.
MASTIF (MIT ANALYSIS AND SYNTHESIS TOOL FOR IC FABRICATION): A WORKSTATION APPROACH TO INTEGRATED CIRCUIT PROCESS AND DEVICE DESIGN M.S. Thesis
Duane S. Boning Jun. 1986 42 p
(Contract N00014-85-K-0213)
(AD-A171795; VLSI-MEMO-86-325) Avail: NTIS HC A03/MF A01 CSCL 09/5

The design of integrated circuits increasingly requires the use of computer aided design tools. While collections of integrated tools exist for system, logic, circuit, and layout aspects of VLSI design, very few similar systems have been built to address process

and device design. The research reported in this thesis has had three goals. First, the requirements of a process and device design environment have been investigated. It is proposed that functional capabilities in specification, synthesis, capture, verification, simulation, and analysis are all needed in both the process design and device design domains. The second goal of this research has been to implement a subset of these functions. While simulation programs already exist, limited capabilities in capture, synthesis, verification, and analysis have been implemented as part of this thesis. The third goal has been to integrate these tools into a user-friendly design environment. A workstation providing graphic, window-oriented user interaction has been implemented to satisfy this third goal. The MASTIF (MIT Analysis and Synthesis Tool for IC Fabrication) workstation is described and illustrated in this thesis. Author (GRA)

N87-16220# Northeastern Univ., Boston, Mass.
SIGNAL PROCESSING CIRCUIT DEVELOPMENT Final Technical Report, May 1983 - Sep. 1985
Basil L. Cochrun Jul. 1986 96 p
(Contract F19628-83-C-0087)
(AD-A171817; RADC-TR-86-69) Avail: NTIS HC A05/MF A01 CSCL 17/5

This final technical report covers the development of electronic circuitry for operation of an IRCCD Camera using a 39,040 Schottky diode detector focal plane. The focal plane is an interline transfer CCD having a 160 (horizontal) by 244 (vertical) pts; photo diode matrix. The camera system consists of a sensor head and a signal processing unit. Both packages are small enough to satisfy airline requirements for carry-on luggage. GRA

N87-16221# Mission Research Corp., Alexandria, Va.
THE ERODING FOIL SWITCH (EFS) MODEL Technical Report, 30 Sep. - 31 Dec. 1985
John E. Brandenburg and Robert E. Terry 1 Jan. 1986 46 p
(Contract DNA001-84-C-0208; DNA Proj. T99-QMXL)
(AD-A171863; MRC/WDC-R-103; DNA-TR-86-83) Avail: NTIS HC A03/MF A01 CSCL 10/2

An analysis of the results of two experiments, the Los Alamos Foil Switch Experiment and the Magnetic Gate Experiment, reveals evidence of mass loss and unexpectedly high temperatures in strongly accelerated aluminum foils. Nonlinear magnetic diffusion theory is analyzed both analytically and numerically and found to give strong concentrations of current density, in a propagating front, for foils thicker than a classical skin depth. This concentrated current front is found to lead to mass erosion and high temperatures in foils undergoing strong acceleration. These results are used to formulate a new model of foil kinematics called the EFS model that features both a rocket (or mass loss) phase, and a snowplow (shock wave) phase after foil disassembly. This model is shown to give good agreement with experimental results. GRA

N87-16222# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
FABRICATION AND MODELING OF AMBIPOLAR HYDROGENATED AMORPHOUS SILICON THIN FILM TRANSISTORS Ph.D. Thesis
Harold F. Bare, Jr. Aug. 1986 179 p
(AD-A171908; AFIT/CI/NR-86-141D) Avail: NTIS HC A09/MF A01 CSCL 09/1

The hydrogenated amorphous silicon (a-Si:H) thin film transistor (TFT) has been studied extensively for several years. Its application as a switching element in large area liquid crystal display arrays has been demonstrated. Modeling studies have been performed to quantify and explain the performance of the a-Si:H TFT. However, throughout these investigations little has been reported concerning the ambipolar nature of the a-Si:H TFT; that is, the ability of the device to operate alternatively as an n-channel or a p-channel device. The work described in this thesis extends the previous by specifically addressing the ambipolar behavior of the a-Si:H TFT. In particular, a process sequence has been developed to fabricate high quality ambipolar a-Si:H TFTs with emphasis on ohmic source/drain contacts. Using experimental data from these devices and TFT theory, a model has been developed for obtaining the output drain current vs. drain voltage of ambipolar a-Si:H TFTs. The model involves the numerical integration of an interpolated sheet conductance function. By using the appropriate flat-b and voltage, the model accurately predicts the experimental output drain current characteristics for both n- and p-type operation over many orders of magnitude. GRA

N87-16223# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.
MAGNETIC CONTROL OF LOW-PRESSURE DISCHARGES Annual Progress Report, 15 Aug. 1985 - 16 Aug. 1986
Karl H. Schoenbach Aug. 1986 53 p
(Contract N00014-85-K-0602)
(AD-A171928; APR-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

In low pressure discharges, operated in electronegative gas mixtures to the right of the Paschen curve minimum, the discharge resistance can be increased by application of transverse magnetic fields. This effect allows the use of a magnetically controlled glow discharge as an opening switch with submicrosecond opening time, or to shorten the recovery time considerably if it is used as a closing switch. The application of a magnetic field transverse to an electric field in a low pressure discharge causes a shift in the electron energy distributions towards lower energies. This shift affects the transport and rate coefficients, and consequently the resistance of the discharge. In order to model magnetically controlled glow discharges Monte Carlo codes are used to determine the rate and transport coefficients in He:SF6 gas mixtures. With the obtained values the equilibrium electric field strength E/N for the positive column of the discharge was calculated. In a 20% SF6/80% He mixture the electric field rises linearly with a slope of about 1 (kV/cm)/Tesla. Besides steady-state characteri stics the transient dynamic response of the positive column to the change of the magnetic field was calculated. GRA

N87-16224# Air Force Weapons Lab., Kirtland AFB, N. Mex.
METAL OXIDE VARISTOR BURN-IN Final Report, Aug. - Nov. 1985
David H. Hilland Jun. 1986 67 p
(AD-A171934; AFWL-TR-85-151) Avail: NTIS HC A04/MF A01 CSCL 09/1

Varistor degradation from unipolar transient pulsing is described. Metal-Oxide varistors (MOVs) subjected to a single high-energy transient displayed an increase in standby current and a decrease in clamping voltage. The amount of degradation was dependent on the polarity of the measurement relative to the polarity of the pulsing, as well as the energy rating of the device. After one pulse, the clamping voltage is lower when measured at the port opposite to the pulsing than when measured at the same port which was pulsed. Polarization of permanent electric dipoles in the insulating intergranular matrix and the filling of traps at the metal oxide grain boundaries are discussed as possible mechanisms for the degradation. Author (GRA)

N87-16225# California Univ., Berkeley. Electronics Research Lab.
JOINT SERVICES ELECTRONICS PROGRAM Annual Progress Report, 1 May 1985 - 30 Apr. 1986
W. G. Oldham Apr. 1986 41 p
(Contract F49620-84-C-0057)
(AD-A171993; UCB/ERL-86/1; AFOSR-86-0692TR) Avail: NTIS HC A03/MF A01 CSCL 09/5

An annual report of the JSEP (Joint Services Electronics Program) in Electromagnetics, Quantum Electronics, Solid State Electronics, Materials and Devices and Information System is presented. In addition, results of the research to date are summarized and significant accomplishments are indicated. GRA

N87-16226 Department of the Air Force, Washington, D.C.
T-SECTION DIGITAL PHASE SHIFTER APPARATUS Patent
Binboga S. Yarman, inventor (to Air Force) Issued 29 Jul. 1986 5 p Supersedes US-Patent-Appl-SN-767454
(AD-D012467; US-Patent-4,603,310; US-Patent-Appl-SN-767454; US-Patent-Class-33-139) Avail: US Patent and Trademark Office

CSCL 09/5

An extra high frequency T-section digital phase shifter apparatus having a pair of back to back diodes connected between the input and output terminals with a parallel circuit connected between the common junction and ground is described. The shunt parallel circuit has an inductor in parallel with the series combination of a capacitor and a diode to provide a balanced insertion loss at each diode switching state. When the diodes are in the forward-biased state they act as closed short circuit switches and in the shunt circuit, the inductance resonates with the diode capacitance to provide a perfect transmission for the RF signal. GRA

N87-16227 Department of the Air Force, Washington, D.C.
ELECTROMECHANICAL SWITCH Patent
Anthony P. Antonuzzi, inventor (to Air Force) and Donald J. Carignan, inventor (to Air Force) Issued 17 Jun. 1986 12 p Supersedes US-Patent-Appl-SN-647781
(AD-D012471; US-Patent-4,595,808; US-Patent-Appl-SN-647781; US-Patent-Class-200-37) Avail: US Patent and Trademark Office CSCL 19/1

A hardened electromechanical switch is disclosed. When appropriate electrical contacts and pick-offs are aligned, four switches close. The possible number of switch combinations selectable are 4095 based upon a base eight counting system. The switch has a counter section and a memory section. The counter section uses an odometer like device based upon octal. Each counter wheel of the counter section has an electrical pick-off that interacts with the memory section. In the memory section, a plurality of octal numbers, four, are entered into and locked thereon such that each counter set disk, four, therein has one octal number thereon. Electrical contacts are placed on the counter set disks of the memory section and these touch the pick-offs of the counter wheels which will simultaneously close on the four contacts of the counter set disk in only one of the 4095 combinations noted above. GRA

N87-16228 Department of the Air Force, Washington, D.C.
MULTI-ROW CONNECTOR WITH GROUND PLANE BOARD Patent
Jack C. Cunningham, inventor (to Air Force), Benjamin G. Egerton, Jr., inventor (to Air Force), and John A. Partridge, inventor (to Air Force) Issued 29 Jul. 1986 5 p Supersedes US-Patent-Appl-SN-708909
(AD-D012494; US-Patent-4,602,832; US-Patent-Appl-SN-708909; US-Patent-Class-339-14) Avail: US Patent and Trademark Office CSCL 09/5

A multi-row connector having a ground plane board mounted between rows of connector pins on the backside of the connector is described. Conductor shields of individual wires are soldered directly to conductor strips on the printed circuit ground plane board, and the strips are jumpered to a grounding pin on the connector. Author (GRA)

N87-16229 Department of the Air Force, Washington, D.C.
TRIGGERED SPARK GAP DISCHARGER Patent
Roy E. Wootton, inventor (to Air Force) Issued 5 Aug. 1986 5 p Supersedes US-Patent-Appl-SN-617449
(AD-D012496; US-Patent-4,604,554; US-Patent-Appl-SN-617449; US-Patent-Class-315-330) Avail: US Patent and Trademark Office CSCL 09/1

This patent discloses a triggered spark gap discharger having a small auxiliary gap in the trigger pulse path. The auxiliary gap provides ultraviolet radiation to liberate electrons at the trigger probe and allows prompt firing of the trigger gap and primary gap, particularly in aged discharger units. Author (GRA)

N87-16230 Department of the Air Force, Washington, D.C.
TALLY CELL CIRCUIT Patent
James L. Burrows, inventor (to Air Force) and Stephen B. Butler, inventor (to Air Force) Issued 19 Aug. 1986 6 p Supersedes US-Patent-Appl-SN-643203
(AD-D012518; US-Patent-4,607,176; US-Patent-Appl-SN-643203; US-Patent-Class-307-449) Avail: US Patent and Trademark Office CSCL 09/1

A tally cell circuit for counting the number of logical ones in an input signal utilizing a parallel-series combination of four CMOS field-effect transistors is described. The number of input ones in the input are expressed in a binary code at the output of the tally cell circuit. GRA

N87-16231# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DIAGNOSIS OF ANALOG ELECTRONIC CIRCUITS: A FUNCTIONAL APPROACH M.S. Thesis
Donald R. Wunz, Jr. Mar. 1986 125 p
(AD-A172718; AFIT/GCS/ENG/86M-3) Avail: NTIS HC A06/MF A01 CSCL 09/5

This describes and proposes an analog electronic circuit diagnostic system using functional knowledge and an artificial intelligence expert system. A prototype of the system is implemented using the KEE expert system building tool to demonstrate its applicability. Functional knowledge is used to analyze the circuit instead of just the structural information widely used now. This permits a more specific identification of bad components within a circuit. The current system in use at Warner Robins Air Logistic Center returns lists of bad components ranging in length up to 25 and 30 individual parts. Functional reasoning will enable the system to further restrict the specification of bad parts. Research into the current literature provides the background and basic knowledge needed to determine the required information for the diagnostic system knowledge base. The system described in this paper proposes the use of a functional rule knowledge base in addition to a structural data base to perform a more complete diagnosis than is now done by the system in use at some Air Force logistic centers. GRA

N87-16232# Stanford Univ., Calif. Lab. of Physics.
PHYSICAL CONCEPTS AND MODELING PROCEDURES FOR PICOSECOND AND SUBPICOSECOND DISTRIBUTED CIRCUITS Interim Report
B. A. Auld and D. M. Bloom Aug. 1986 8 p
(Contract N00014-85-K-0381)
(AD-A172828) Avail: NTIS HC A02/MF A01 CSCL 09/3

This contract has been focused on three primary projects: modeling and development of a nonlinear transmission line for the production of picosecond pulses; modeling and development of a tapered microstrip coupler; and the modeling and characterization of the accuracy of the electrooptic sampling system. The projects share the goal of facilitating the development of ultrafast electronics and the ability to characterize them. GRA

N87-16233# AiResearch Mfg. Co., Torrance, Calif.
ADVANCED HIGH-POWER GENERATOR RESEARCH PROGRAM Final Report, Jan. 1984 - Oct. 1985
Tracy E. Johnson May 1986 134 p
(Contract F33615-76-C-2168)
(AD-A172885; Rept-85-22686; AFWAL-TR-86-2015) Avail: NTIS HC A07/MF A01 CSCL 10/2

This report summarizes work accomplished in phase 3 of the advanced high-power generator research and development program, F33615-76-C-2168, part of an Air Force exploratory development program for high-power airborne electrical power supply technology. The program includes the design of a 5-mw generator for use in a 10-mw power supply and fabrication and testing of the generator rotor. The five program phases are: phase 1, design; phase 2, critical component testing; phase 3, rotor fabrication; phase 4, rotor testing; and phase 5, test plan preparation. The overall objective of the exploratory development program is to demonstrate through prototype hardware testing, that an ultralightweight (0.1 lb/kw), nonsuperconducting generator can be successfully built in the 1-to-10-mw power range. The program was terminated at the end of phase 3. This report covers the fabrication of a samarium-cobalt permanent magnet rotor which included: HIP-(hot isostatic pressure) bonding, heat treating, machining, magnet assembly, sleeve installation, and spinning. GRA

N87-16234# Defence Research Establishment, Ottawa. (Ontario).
THE DEVELOPMENT OF A HIGH SPEED EXPONENTIAL FUNCTION GENERATOR FOR LINEARIZATION OF MICROWAVE VOLTAGE CONTROLLED OSCILLATORS
J. F. Mickeal, J. J. Renaud, and M. R. McMillan Oct. 1985 40 p
(AD-A173714; DREO-TN-86-3) Avail: NTIS HC A03/MF A01 CSCL 09/1

Voltage Controlled Oscillators (VCO) used in radar signal simulators usually employ piecewise approximation linearizers to compensate for nonlinear frequency versus voltage tuning characteristics. A linearizer was developed which closely approximates an exponential (frequency/voltage) relationship found in many VCO's. This linearizer uses the forward biased (voltage/current) characteristic of a p-n junction to provide exponential linearization in a simple, thermally stable, wide band circuit. Author

N87-16235# Naval Postgraduate School, Monterey, Calif.
BRUSHLESS dc MOTORS, VELOCITY AND POSITION CONTROL OF THE BRUSHLESS dc MOTOR M.S. Thesis
Nezih Y. Durusu Jun. 1986 103 p
(AD-A173997) Avail: NTIS HC A06/MF A01 CSCL 10/2

A velocity feedback controller for the brushless dc motor was designed using the Hall effect sensors. In addition, the position control of the brushless dc motor was developed using an optical encoder to sense angular position changes and a microprocessor to provide the desired position control. A Pittman 5111 wdg 1 brushless dc motor was used for this study. The design of the digital tachometer and pulse width modulator for velocity control and the design of the Z-80 based microprocessor controller and software design are described in detail. GRA

N87-16236# California Inst. of Tech., Pasadena. Dept. of Applied Physics.
SMALL STRUCTURES AND SUPERLATTICES FOR FUTURE HIGH-SPEED DEVICES Annual Technical Report, 15 Nov. 1983 - 1 Oct. 1986
T. C. McGill 1 Oct. 1986 88 p
(Contracts N00014-84-C-0083; DARPA Order 4833)
(AD-A174155) Avail: NTIS HC A05/MF A01 CSCL 09/5

Novel microstructures for high speed and high density electronics are studied with simulations on five new three-terminal devices. One of the latter was successfully fabricated and used to measure the dc current voltage characteristics. The desired three-terminal device behavior has been observed at 300K and 77K. The installation of a picosecond pulser has been completed and is being used to obtain some of the first measurements of the response time of tunneling devices. A capability to simulate the process of making high speed measurements with microstrip lines is developed. This simulation capability will be essential in interpreting the results of the high speed measurements. The development of a small Si MBE growth chamber is completed and silicide-silicon structures are being grown in this system. A unique MBE facility is in process of installation. It will include provision for growing group IV semiconductors and silicides, III-V semiconductors, analyzing structures, using Auger and ESCA, and a metallization chamber that includes not only the provision for evaporating metals but can be used as an introchamber for a more extensive processing facility. This facility is unique in the world but is serving as a prototype for systems planned by other groups. Some basic studies of the properties of GaAs-GaAlAs interfaces that are basic to their use in novel device structures have been carried out. GRA

N87-16237# Sandia National Labs., Albuquerque, N. Mex. Computer Communications Design Div.
LOOPBACK TESTER: A SYNCHRONOUS COMMUNICATIONS CIRCUIT DIAGNOSTIC DEVICE
J. H. Maestas Jul. 1986 70 p
(Contract DE-AC04-76DP-00789)
(DE86-014935; SAND-85-0866) Avail: NTIS HC A04/MF A01

The Loopback Tester is an Intel SBC 86/12A Single Board Computer and an Intel SBC 534 Communications Expansion Board configured and programmed to perform various basic tests on synchronous communication circuits of 100 kbps or less. These tests include: (1) Data Communications Equipment (DCE) transmit timing detection, (2) data rate measurement, (3) instantaneous loopback indication, and (4) bit error rate testing. It requires no initial setup after plug in, and can be used to locate the source of communications loss in a circuit. It can also be used to determine when crypto variable mismatch problems are the source of communications loss. This report discusses the functionality of the Loopback Tester as a diagnostic device. It also discusses the hardware and software which implement this simple yet reliable device. DOE

N87-16238# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
MODELING OF POROUS ELECTRODES IN MOLTEN-SALT SYSTEMS
J. Newman Aug. 1986 20 p Presented at the International Workshop on High Temperature Molten Salt Batteries, Argonne, Ill., 16 Apr. 1986
(Contract DE-AC03-76SF-00098)
(DE87-000130; LBL-21867; CONF-8604116-6) Avail: NTIS HC A02/MF A01

Porous electrodes are used for many batteries because they permit the reactants to be close to the site of the electrochemical reaction. The basis for a nonuniform reaction distribution in such electrodes is reviewed, and some results are discussed for lithium alloy, iron sulfide cells. Discrepancies between model and experimental results can be attributed to poor approximations to the effective conductivity of packed-bed electrodes and to inadequate treatment of the precipitation of KCl. DOE

N87-16239# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
INTERELEMENT INTERACTIONS IN PHASED ARRAYS: THEORY. METHODS OF DATA ANALYSIS AND THEORETICAL SIMULATIONS
L. A. Muth Dec. 1985 50 p
(PB86-237203; NBS-TN-1091) Avail: NTIS HC A03/MF A01 CSCL 09E

A theoretical review is done of the effects of multiple reflections and mutual impedances in array environments. Possible methods of far-field pattern data analysis to recover interaction effects are studied. The authors use theoretical expressions derived earlier to calculate in a two-element linear array the mutual-impedance matrix and effective excitations of elements as functions of interelement separation and n sub max, the maximum mode number in the radiation pattern of the elements. Generalizations to two- and three-dimensional arrays are discussed. GRA

N87-16325*# Ball Bros. Research Corp., Boulder, Colo.
SLIP RING EXPERIENCE IN LONG DURATION SPACE APPLICATIONS
Damon D. Phinney *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 45-54 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

N87-16334*# Moore Reed and Co. Ltd., Andover (England).
REDUNDANCY FOR ELECTRIC MOTORS IN SPACECRAFT APPLICATIONS
Robert J. Smith and Alastair R. Flew *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 179-194 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

N87-16335*# Hughes Space and Communications Group, El Segundo, Calif.
RF SWITCH POSITIONER FOR COMMUNICATIONS SATELLITE NETWORK
A. G. Storaasli, H. P. Griesser, and R. W. Grant *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 195-203 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

N87-16755*# Tennessee Univ., Martin. School of Engineering Technology and Engineering.
AUTONOMOUSLY MANAGED ELECTRICAL POWER SYSTEMS
Charles P. Callis *in* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N87-16240 Carnegie-Mellon Univ., Pittsburgh, Pa.
DISPERSED FLOW HEAT TRANSFER IN EXTERNAL LAMINAR BOUNDARY LAYERS Ph.D. Thesis
Jayprakash Narayan Kabadi 1986 188 p
Avail: Univ. Microfilms Order No. DA8616508

Dispersed flow heat transfer in external laminar boundary layers is investigated. Equations are formulated considering velocity slip between the phases, and the variations in the diameter and the number density of the dispersed phase. The equations are valid for flows of a mixture of vapor containing suspended droplets/particles. Important non-dimensional parameters are identified by studying their effects on the dispersed flow heat transfer. The dimensionless parameters identified to have a strong influence on the wall heat transfer are, the void fraction, the particle-gas interaction parameter, the volatility parameter and the density ratio. The void fraction is observed to have a significant effect on the wall heat transfer, consistent with other studies in the literature. The particle-gas interaction parameter, RE sub s/RE sub p sup 2 whose value depends on the particle/droplet size, is concluded to be another important parameter in the dispersed flow heat transfer. The volatility parameter, S sub v, is a measure of the droplet evaporation, and produces effects similar to the injection at the wall. As the value of this parameter is increased, the wall heat transfer coefficient is found to decrease. Finally, the heavy particles are seen to increase the wall Nusselt number value. Useful plots showing the effects of the above parameters on the values of Nu sub x/sq. rt. RE sub x, are provided for the cases of constant wall heat flux boundary condition. Dissert. Abstr.

N87-16241 Stanford Univ., Calif.
NONLINEAR TRANSIENT PHENOMENA IN A THREE-DIMENSIONAL CAVITY FLOW: A NUMERICAL INVESTIGATION Ph.D. Thesis
Christopher Joseph Freitas 1986 258 p
Avail: Univ. Microfilms Order No. DA861273

A role of numerical methods in engineering research is illustrated. Three complex flows in a three-dimensional cavity were simulated and an extensive data base was generated which complements data measured in concurrent physical experiments. The numerical investigation's objective was to improve understanding of physical phenomena in laminar and turbulent recirculating flows with and without buoyancy effects. Three flows are simulated in a three-dimensional cavity (150 mm by 150 mm by buoyancy driven natural convection and mixed convection. These simulations are based on the concept of Direct Numerical Simulation and use the REMOXCS code. The major numerical achievement is the development and implementation of an efficient and robust QUICK-type scheme, tested for a variety of flow conditions within the cavity. The dominant physical phenomena in the shear-driven flow simulation are Taylor-Gortler (TG) vortices. This is the first simulation to replicate TG vortex phenomena in a cavity and reproduce their consistent physical development. The simulation of natural convection in a cavity reveals that the stabilizing influence of vertical walls inhibits large Rayleigh number flows from developing to fully turbulent flows. The dynamics of the mixed convection flow are determined by complex interactions among the recirculating flow, pressure-driven secondary flows, TG vortices, and buoyancy. TG vortex phenomena and their influence on surface heat flux are accurately reproduced. Dissert. Abstr.

N87-16242 ESDU International Ltd., London (England).
HIGH-FIN STAGGERED TUBE BANKS: HEAT TRANSFER AND PRESSURE DROP FOR TURBULENT SINGLE PHASE GAS FLOW
Oct. 1986 32 p
(ESDU-85022; ISBN-0-85679-574-7; ISSN-0141-402X) Avail: ESDU

This Data Item ESDU 86022 is an addition to the Heat Transfer Sub-series. New correlations are presented for external heat transfer coefficient and static pressure loss for single phase flow over plain circular fins of either retangular or tapered cross section on round tubes. The correlations were derived by a regression analysis of experimental results extracted from the literature for a wide range of tube bundle configurations. Fin densities of 4 to 11 per inch (equivalent to fin pitches of 6.4 to 2.3 mm) tube outside diameters of 3/8 to 2 inch (10 to 51 mm), fin heights of 1/4 to 5/8 inch (6 to 16 mm), and ratios of fin tip to fin root diameter of 1.2 to 2.4 were covered. For heat transfer the range of Reynolds number based on tube outer diameter was from 2,000 to 40,000 and for pressure drop from 5,000 to 50,000. Comparison of the prediction with experiment shows that for heat transfer 85% of the data points were within 10% of estimated and for pressure drop 72% were within 10%. A comprehensive worked example showing the use of the method for an air cooled heat exchanger bundle is included. The applicability of this method to nonintegral fins is considered and factors influencing the thermal resistance of the interface are discussed. Effects of fouling are also briefly covered. ESDU

N87-16243 ESDU International Ltd., London (England).
BOILING INSIDE TUBES: CRITICAL HEAT FLUX FOR UPWARD FLOW IN UNIFORMLY HEATED VERTICAL TUBES
Nov. 1986 40 p
(ESDU-86032; ISBN-0-85679-584-4; ISSN-0141-402X) Avail: ESDU

ESDU 85041 recommended a procedure for estimating the heat flux at different locations along a heated tube through which a boiling liquid is flowing, assuming that the wall is wetted by the liquid. The purpose of this Data Item (ESDU 86032) is to enable the reader to check, in the case of flow up a uniformly heated vertical tube, that the heat flux does not exceed the critical value above which the liquid would not wet the wall. This point marks the onset of dryout accompanied by an increase in resistance to heat transfer and the possible onset of corrosion and overheating of the tube. The open literature contains many experimental values of the critical heat flux (CHF) in flow up electrically heated vertical tubes, mostly with water or R.12. These results have been used to check various procedures for predicting CHF with flow up vertical tubes. The recommended procedure is given in detail and illustrated in an example. ESDU

N87-16244 ESDU International Ltd., London (England).
FOULING OF HEAT EXCHANGER SURFACES: GENERAL PRINCIPLES
Dec. 1986 54 p
(ESDU-86038; ISBN-0-85679-590-9; ISSN-0141-402X) Avail: ESDU

This Data Item ESDU 86038 is an addition to the Heat Transfer Sub-series. The importance of various parameters that affect fouling are discussed. Appropriate methods for dealing with fouling in all stages from design through to operation of heat exchanger equipment are indicated. Methods of suppressing fouling by additives, or of cleaning equipment chemically or mechanically, are considered. A brief outline of the physical process of fouling including some mathematical models is given. ESDU

N87-16245*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE NONLINEAR DEVELOPMENT OF GORTLER VORTICES IN GROWING BOUNDARY LAYERS Final Report
Philip Hall Dec. 1986 53 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178215; ICASE-86-83; NAS 1.26:178215) Avail: NTIS HC A04/MF A01 CSCL 20D

The development of Gortler vortices in boundary layers over curved walls in the nonlinear regime is investigated. The growth of the boundary layer makes a parallel flow analysis impossible except in the high wavenumber regime so in general the instability equations must be integrated numerically. Here the spanwise dependence of the basic flow is described using Fourier series expansion whilst the normal and streamwise variations are taken into account using finite differences. The calculations suggest that a given disturbance imposed at some position along the wall will eventually reach a local equilibrium state essentially independent of the initial conditions. In fact, the equilibrium state reached is qualitatively similar to the large amplitude high wave-number solution described asymptotically by Hall (1982). In general, it is found that the nonlinear interactions are dominated by a mean field type of interaction between the mean flow and the fundamental. Thus, even though higher harmonics of the fundamental are necessarily generated, most of the disturbance energy is confined to the mean flow correction and the fundamental. A major result of the calculations is finding that the downstream velocity field develops a strongly inflection character as the flow moves downstream. The latter result suggests that the major effect of Gortler vortices on boundary layers of practical importance might be to make them highly receptive to rapidly growing Rayleigh modes of instability. Author

N87-16246# Pennsylvania State Univ., University Park. Applied Research Lab.
UNSTEADY GAS DIFFUSION ACROSS A TWO-DIMENSIONAL PERMEABLE CAVITY SURFACE
K. Ravindra 31 Jul. 1986 30 p
(Contract N00024-85-C-6041)
(AD-A172155; ARL/PSU/TM-86-119) Avail: NTIS HC A03/MF A01 CSCL 20/4

A mathematical analysis is formulated and solved for the unsteady diffusion of gases across a two dimensional cavity surface. The analysis takes into account the effect of variations in cavity length as well as cavity pressure on the unsteady gaseous diffusion. The result of this mathematical analysis approaches the proper limit for steady gas diffusion across a two dimensional cavity surface when the reduced frequency of oscillation goes to zero. GRA

N87-16247# Sheffield Univ. (England). Dept. of Chemical Engineering and Fuel Technology.
VELOCITY MEASUREMENT BY PULSED DOPPLER Final Report, Sep. 1984 - Sep. 1985
Bruce C. Ewan and J. Swithenbank 16 Nov. 1985 23 p
(Grant AF-AFOSR-0374-84)
(AD-A172517; HIC-446; AFOSR-86-0839TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

The optical monitoring of fluid flows and particulates has in the past generally divided between those methods which provide a single snapshot over a wide field diameter and those which provide a continuous record at a single point. Laser Doppler anemometry comes into the latter category and it is clear that in order to accumulate the same information on the spatial distribution of velocity as wide field methods, a traversing of the field must be carried out. While this is commonplace among users of LDA, it requires that the velocity field be steady or at least reproducible in short between tests, single firings or periodic systems. The motivation behind the present program has stemmed from the perceived need to overcome the single point capability of LDA in certain cases of interest to USAF. These were originally seen to be short rocket motor firings, which typically last for only a few seconds, but are now considered to include the growing area of time dependent 3-D flow measurement. This letter is now known to be at the heart of many simple combustion systems involving large scale mixing. GRA

N87-16248 Department of the Air Force, Washington, D.C.
HYDRAULIC PRESSURE INTENSIFIER Patent
Robert S. Andrews, inventor (to Air Force) Issued 22 Jul. 1986 5 p Supersedes US-Patent-Appl-SN-782630
(AD-D012490; US-Patent-4,601,642; US-Patent-Appl-SN-782630; US-Patent-Class-417-225) Avail: US Patent and Trademark Office CSCL 13/7

A hydraulic pressure intensifier is used to raise the pressure in an accumulator above a given input pressure. An oscillating piston provides a boost pressure while a pilot valve and a dump valve and restrictors allow the oscillating piston to move.
Author (GRA)

N87-16249# Wisconsin Univ., Madison. Mathematics Research Center.
ON HOLE-PRESSURES IN PLANE POISEUILLE FLOW OVER TRANSVERSE SLOTS Technical Summary Report
D. S. Malkus and Minwu Yao Jul. 1986 19 p
(Contract DAAG29-80-C-0041; Grant AF-AFOSR-0141-85)
(AD-A172586; MRC-TSR-2943) Avail: NTIS HC A02/MF A01 CSCL 20/4

The derivation of the stress-integral form of the Higashitani-Pritchard-Baird-Lodge relation cannot be applied to plane Poiseuille flow. It ignores the contribution of the streamwise pressure gradient, and doing so can lead to contradictions. Furthermore, the variable change which leads to the stress-integral form of the HPBL relation is not valid in a second-order fluid approximation for slow flows. Correcting these deficiencies leads to a modified relation which appears intractable. Nevertheless, the Tanner-Pipkin result that P sub e = N sub 1/4 in a second order fluid is valid when properly interpreted. GRA

N87-16250# Wisconsin Univ., Madison. Mathematics Research Center.
A NUMERICAL METHOD FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN THREE-DIMENSIONAL CYLINDRICAL GEOMETRY Technical Summary Report
John C. Strikwerda and Yvonne M. Nagel Aug. 1986 20 p
(Contract DAAG29-80-C-0041; Grant NSF MCS-83-06880)
(AD-A172591; MRC-TSR-2948) Avail: NTIS HC A02/MF A01 CSCL 20/4

The authors finite difference describe a method for solving the steady, three-dimensional, incompressible Navier-Stokes equations in cylindrical geometry. Also, they present results of computations in which this method is used to determine the flow in fluid-filled cylinders undergoing spinning and coning motion. Second-order accurate central finite difference formulas are used to approximate derivatives in the radial and axial directions and a Fourier method is used to approximate the angular derivatives. Nonuniform grids are used to improve the resolution of the velocity and pressure near the cylinder walls. The system of difference equations are solved using an iterative method based on successive-over-relaxation. The method has been found to be very efficient in terms of both computer time and storage. Results of the numerical method applied to the flow in spinning and coning cylinders are presented for several cases for which experimental data are available. In addition, perturbation methods are used to study the data at small coning speeds and small coning angles. Numerical results of the no-coning limit are compared with both the numerical data and experimental data at low coning conditions. s of this no-coning limit are compared with both the numerical data and experimental data at low coning conditions. GRA

N87-16251# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
COMPUTATIONAL METHODS FOR COMPLEX FLOW FIELDS Annual Report
Earll M. Murman and Judson R. Baron 28 Jun. 1986 47 p
(Grant AF-AFOSR-0136-82)

(AD-A172727; AFOSR-86-0868TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

Development of solution algorithms for complex flowfields is the continuing objective of the research. The physical events are used to determine appropriate subdomains for both preselected and adaptive divisions of the field. Adapted embedding procedures have been completed for two-dimensional Euler flow with considerations of most suitable decision parameters. Development of an algorithm which combines cell and nodal-centered features continues for applications to less restrictive embedded topology. A mixed implicit/explicit approach for different coordinate directions is under study for Navier-Stokes flow. The Dec. 1984 Jerusalem Workshop is summarized briefly. GRA

N87-16252# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.

FLUID DYNAMIC MECHANISMS AND INTERACTIONS WITHIN SEPARATED FLOWS Final Technical Report, 1983 - 1986

A. L. Addy, W. L. Chow, J. C. Dutton, H. H. Korst, and R. A. White Jul. 1986 256 p

(Contract DAAG29-83-K-0043)

(AD-A172814; UILU-ENG-86-4006; ARO-19823.19-EG) Avail: NTIS HC A12/MF A01 CSCL 20/4

The component mechanisms and interactions which establish and maintain high-speed separated flow regions are discussed. Flow models and theoretical analyses have been developed to describe the base flowfield. The research approach has been to conduct extensive small-scale experiments on base flow configurations and to analyze these flows by component models and finite-difference techniques. Modeling of base flow of missiles (both unpowered and powered) for the transonic flight regime has been successful by component models based on the equivalent body approach. Development and use of a state-of-the-art laser Doppler velocimeter system for experiments with two-dimensional small-scale models in supersonic flows have provided quality, well-documented velocity data. The LDV experiments yielded mean and turbulence information for a variety of near-wake flow mechanisms such as initial shear layer development, recompression/reattachment/redevelopment processes, shock wave-boundary layer interactions, and propulsive jet/freestream interactions. Correlation between the LDV data and component method mixing analysis has yielded results of interest. Research on plume effects and plume modeling has defined the pertinent variables for effective wind tunnel simulation of propulsive nozzle plumes. GRA

N87-16253# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Mechanical Industrial and Aerospace Engineering.

THEORETICAL INVESTIGATION OF 3-DIMENSIONAL SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTIONS, PART 4 Interim Report, 1 Oct. 1984 - 30 Sep. 1985

Doyle D. Knight Jan. 1986 74 p

(Grant AF-AFOSR-0040-82)

(AD-A172826; RU-TR-163-MAE-F; AFOSR-86-0893TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

A theoretical model consists of the Reynolds-averaged 3-D compressible Navier-Stokes equations, with turbulence incorporated using the algebraic turbulent eddy viscosity model of Baldwin and Lomax. This year research efforts focused on both 2-D and 3-D turbulent interactions. A theoretical model was examined for a series of separated 2-D compression corner flows at Mach 2 and 3. Calculations were performed for four separate compression corners using 2-D compressible Navier-Stokes code with MacCormack's hybrid algorithm. Results were compared to earlier computations using the Beam-Warming algorithm, and recent experiment data for turbulent Reynolds stresses. Calculated Reynolds stresses were observed to differ significantly from experimental measurements due to the inability of the turbulence model to incorporate the multiple scale effects of the turbulence structure downstream of reattachment. Computed results using the MacCormack hybrid algorithm were observed to be insensitive to the Courant number. The 3-D turbulence interactions research concentrated on the 3-D sharp fin and on the 3-D swept compression corner. In the former case, the computed flowfield for the 20 deg sharp fin at Mach 3 and a Reynolds number of 930,000 was compared with the calculated results of Horstman (who used the Jones-Launder turbulence model) and experimental data of the Princeton Gas Dynamics Lab. Overall comparison with experiment was very good. GRA

N87-16254# Iowa Univ., Iowa City. Inst. of Hydraulic Research.

FURTHER STUDIES OF UNSTEADY TURBULENT BOUNDARY LAYERS Final Technical Report, 1 Oct. 1982 - 30 Sep. 1986

B. R. Ramaprian (Washington State Univ., Pullman) 25 Sep. 1986 63 p

(Contract DAAG29-83-K-0004)

(AD-A172870; ARO-19652.9-EG) Avail: NTIS HC A04/MF A01 CSCL 20/4

Periodic turbulent boundary layers in zero and adverse time-mean pressure gradient have been studied. The study includes experimental, analytical and numerical investigations. The experiments were conducted in an unsteady-flow water tunnel, in which the freestream velocity varies sinusoidally with time around a mean value. Reduced frequencies up to about 25 and a relative oscillation amplitude of 40 per cent of the mean velocity were studied. Flow reversal occurred over a significant part of the oscillation cycle in the adverse pressure gradient experiments, though no mean-flow separation was observed. Data on turbulent stresses and wall shear stress were obtained using a two-component laser Doppler anemometry and a surface-mounted heat flux gage. A theory and calibration procedure were developed for the use of the latter in unsteady flow. All the experimental data were recorded on magnetic tape. A general asymptotic theory has been developed for unsteady turbulent boundary layers. This theory leads to the development of wall functions for these flows. Such wall functions have been developed and used in a calculation procedure based on the k-epsilon model of turbulence. GRA

N87-16255# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.

TURBULENT BOUNDARY LAYER INDUCED BY THERMAL PRECURSOR

Harold Mirels 20 Jun. 1986 30 p

(Contract F04701-85-C-0086)

(AD-A173715; TR-0086(6785)-2; SD-TR-86-38) Avail: NTIS HC A03/MF A01 CSCL 20/4

An approximate model is presented for estimating the turbulent boundary layer within a thermal precursor generated by the interaction of a shock moving with uniform velocity over a thin semi-infinite heated fluid layer. An unsteady momentum integral formulation is used. The subject boundary layer is related to the shock tube wall boundary layer, to the boundary layer induced by passage of a shock wave over a semi-infinite plate, and to the boundary layer induced by the impulsive by the impulsive motion of a semi-infinite plate. In all cases, the maximum boundary layer thickness and minimum wall shear occur at the streamwise station xi sub m = theta/delta** which connects a similarity solution for xi is less than xi sub m with a similarity solution for xi is greater than xi sub m. A similar result is deduced for the corresponding case of a laminar boundary layer, with xi sub m = 7/9 and 0.384 for the incompressible turbulent and laminar cases, respectively. GRA

N87-16256# Naval Postgraduate School, Monterey, Calif.

FORCED CONVECTION HEAT TRANSFER FROM A FINNED ARRAY WITH AN ADJUSTABLE OUTER CHANNEL BOUNDARY M.S. Thesis

Terry L. Mellon Jun. 1986 205 p

(AD-A174138) Avail: NTIS HC A10/MF A01 CSCL 20/13

An analysis was made of the heat transfer characteristics of an array of longitudinal fins with an adjustable outer channel boundary and a constant heat flux into the base of the array. The channel boundary could be moved to provide fin tip clearance ratios from zero to twice the fin height. Velocity variations in the interfin space and the open channel adjacent to the fin tips caused a variation in the calculated heat transfer coefficients along the

height of the finned array, with the maximum coefficient occurring in the region of maximum velocity. It was shown that fin tip heat loss was a function of the clearance between the fin tip and the outer channel boundary, and that the maximum heat loss could occur on or near the fin tip. It was also shown how the tip heat loss affected the heat transfer characteristics of the array. Centerline velocity profiles and streamline profiles developed for laminar flow with the finned array both heated and unheated. For the heated condition, two heat fluxes were used with three different clearance ratios. Temperature profiles within the fin were developed for the lower heat flux for both laminar and turbulent flow. Laminar flow results were compared to previous analytical work. GRA

N87-16257# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A COMPARISON STUDY OF THE EIGENVALUE METHOD FOR THE SOLUTION OF THE TRANSIENT HEAT CONDUCTION EQUATION M.S. Thesis
David B. Gee Jan. 1986 52 p
(AD-A174153; AFIT/GNE/ENP-86M-6) Avail: NTIS HC A04/MF A01 CSCL 20/13

This is a comparison study of the abilities of the eigenvalue method as a numerical method in solving the transient heat conduction equation. The eigenvalue method was compared to five other numerical methods; Runge-Kutta, Gears, extrapolation, fully implicit, and Crank-Nicolson. The latter were used to solve three physical problems: (1) a two dimensional slap which takes advantage of the symmetry of the problem; (2) the same slap problem without taking advantage of the symmetry; and (3) a cylindrical problem taking full advantage of symmetry. The scope of the study is to see which methods take less computer time while maintaining sufficient accuracy. The time it takes the computer to totally execute the program was used as the time comparison basis. The accuracy is a comparison of the exact solution to the numerical solution. A root mean square average of all the grid points per time step is used. The results of the study were surprising. The accuracy of the eigenvalue method is not any better than that of the Crank-Nicolson method. The computer times show that the eigenvalue is not the fastest for short transient times. A long transient problem with nonlinear terme was not used. GRA

N87-16258# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
ANALYSIS OF THREE-DIMENSIONAL VISCOUS INTERNAL FLOWS Final Report, 1 Mar. 1980 - 28 Feb. 1985
Kirti N. Ghia and Urmila Ghia Dec. 1985 57 p
(Grant AF-AFOSR-0160-80)
(AD-A174497; AFL-85-12-70; AFOSR-86-2059TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

The objective of this study was to acquire improved understanding of viscous internal flows related to turbomachinery components by analyzing appropriate model flow problems. Significant effort was directed towards developing basic computational methods which were made available to interested researchers involved in computational fluid dynamics (CFD) research and to users involved in the design of turbomachinery components. Several analyses were developed and included are: an analysis for the fully developed three-dimensional flow in curved ducts, a parabolized Navier-Strokes analysis for developing flow in curved ducts, an unsteady Navier-Strokes analysis for internal and external flows, adaptive grid generation for one and two dimensional viscous flows, analysis of the Neumann problem in generalized orthogonal coordinates, efficient semi-implicit solution techniques consisting of the alternating direction implicit multigrid and strongly implicit multigrid methods, the direct block Gaussian elimination (GBE) method for solution of the Poisson equation for the unsteady Navier-Stokes analysis of incompressible flows. For the flow inside a shear driven cavity, the asymptotic flow in curved ducts and clarity for interpretation of the available corresponding experimental results and have now become benchmark solutions for these problems. GRA

N87-16259# Argonne National Lab., Ill.
REVERSING FLOW TEST FACILITY Technical Report, Mar. 1986
P. D. Roach Apr. 1986 76 p
(Contract W-31-109-eng-38)
(DE86-014615; ANL-CT-86-1) Avail: NTIS HC A05/MF A01

The Reversing Flow Test Facility (RFTF) is intended for the study of fluid flow and heat transfer under the reversing-flow conditions that occur in Stirling engines. The facility consists of four major parts: (1) Mechanical Drive - two cylinders with cam-driven pistons which generate the reversing gas flow, (2) Test Section - a U-shaped section containing instrumented test pieces, (3) Instruments -I high-speed transducers for measuring gas pressure and temperature, piston positions, and other system parameters, and (4) Data Acquisition System - a computer-based system able to acquire, store, display and analyze the data from the instruments. The RFTF can operate at pressures up to 8.0 MPa, hot-side temperatures to 800 deg. C, and flow-reversal frequencies to 50 Hz. Operation to data has used helium as the working gas at pressures of 3.0 and 6.0 MPa, at ambient temperature, and at frequencies from 1 to 50 Hz. The results show that both frictional and inertial parts of the pressure drop are significant in the heater, coolers and connecting tubes; the inertial part is negligible in the regenerators. In all cases, the frictional part of the pressure drop is nearly in phase with the mass flow. DOE

N87-16260# Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil).
STABILITY ANALYSIS FOR DOWNFLOW IN HEATED CHANNELS M.S. Thesis
P. A. B. de Sampaio 1985 69 p In PORTUGUESE; ENGLISH summary
(DE86-703266; INIS-BR-483) Avail: NTIS (US Sales Only) HC A04/MF A01

Stability and flow distributions are analyzed for downflow in heated channels. It is shown that at low flow rates instabilities associated with the buoyancy forces may appear. A computer code in FORTRAN language to determine downflow distribution among heated channels is presented. The model used to calculate downflow distribution and the onset of instability is compared with experiments performed in a test section with two parallel channels. DOE

N87-16261# Lawrence Livermore National Lab., Calif.
GRANULAR FLOW PROJECT Quarterly Report, Apr. - Jun. 1986
O. R. Walton, ed. 30 Jun. 1986 12 p
(Contract W-7405-eng-48)
(DE87-000906; UCID-20297-86-2) Avail: NTIS HC A02/MF A01

Discrete particle computer models are being utilized in the Granular Flow Project at Lawrence Livermore National Laboratory (LLNL) to study the deformation and flow behavior of granular solids. These direct simulation models follow the motion of each inelastic, frictional particle in an assembly as it interacts with the other particles in the system and/or the boundaries. During the past year the models for the configurations, particles and interaction forces have continued to become more realistic as we developed and improved our simulation techniques. During the current reporting period we continued calculating the properties of systems of equal-sized, inelastic, frictional spheres undergoing steady shear with periodic boundaries on all sides. These calculations are producing shear and normal stress values that are very close to measured values obtained in annular shear cell tests of glass beads. The capability to calculate systems containing a distribution of sphere sizes has been added to the 3DSHEAR model and a study of steady shearing of binary mixtures has been initiated. Coding for real boundaries on up to four sides of the calculational cell is being written and we have added velocity damping to the Hertzian contact force model to more realistically describe velocity-dependent coefficients of restitution. We have also begun examining the feasibility of modifying a rigid-body molecular-dynamics program to include inelastic, frictional particles. Such a

model will allow us to perform calculations of many configurations using as little as one-tenth of the computer time of our current models. DOE

N87-16262# California Univ., Berkeley. Lawrence Berkeley Lab.
NUMERICAL STUDY OF SUPERFLUID TURBULENCE IN THE SELF-INDUCTION APPROXIMATION Ph.D. Thesis
T. F. Buttke Aug. 1986 130 p
(Contract DE-AC03-76SF-00098)
(DE87-000926; LBL-22086) Avail: NTIS HC A07/MF A01

A numerical method is presented that determines the evolution of a superfluid vortex, and it is used to calculate some properties of turbulent superfluid vortex systems. A stable finite difference method is derived for solving the self-induction equation in vortex dynamics. The self-induction equation is equivalent to a non-linear Schroedinger equation. A numerical method is designed that preserves some of the invariants of the Schroedinger equations; this leads to stability. The method is written in terms of the tangent field of the vortex lines. It is shown that the approximate solutions exist for all times and for all initial conditions. This is the first stable numerical method for solving the self-induction equation. A new exact self-similar solution of the self-induction equation is found and this solution is used along with the previously known soliton solutions to validate the method. The method is second order accurate in space and time. The equations which govern the evolution of a superfluid vortex are viewed as a perturbation of the self-induction equation and a method is developed for determining the evolution of a superfluid vortex. The reconnection ansatz of Schwarz is incorporated into the method. The method is validated by comparison with known exact solutions and by a careful convergence check for cases where the exact solution is not known. If the spatial step in the approximation is chosen too large the approximate solutions became inaccurate. Following the work of Schwarz experiments on vortex systems are performed to find the line length density of a turbulent superfluid. The turbulence produced is not homogeneous, and line length densities and critical properties disagree with earlier results. DOE

N87-16185# Joint Publications Research Service, Arlington, Va.
TURBULENT BOUNDARY LAYER AT MOVING SURFACE OF CYLINDRICAL BODY
V. M. Zubarev *In its* USSR Report: Engineering and Equipment 24 Feb. 1986 p 75-76 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 5, Sep. - Oct. 1984 p 61-67 (For primary document see N87-16179 08-31)
Avail: NTIS HC A07/MF A01

N87-16570# Joint Publications Research Service, Arlington, Va.
INTERACTION OF AIR SHOCK WAVES AND POROUS COMPRESSIBLE MATERIALS Abstract Only
L. G. Gvozdeva, Yu. M. Faresov, and V. P. Fokeyev *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 11-12 Transl. into ENGLISH from Zhurnal Prikladnoy Mekhaniki i Tekhnicheskoy Fiziki (Novosibirsk, USSR), no. 3, May - Jun. 1985 p 111-115 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16581# Joint Publications Research Service, Arlington, Va.
MODELING OF PRESSURE WAVES FORMED DURING DETONATION AND COMBUSTION OF GAS MIXTURES Abstract Only
A. A. Borisov, V. Ye. Gelfand, and S. A. Tsyganov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 113 Transl. into ENGLISH from Fizika Goreniya i Vzryva (Novosibirsk, USSR), v. 21, no. 2, Mar. - Apr. 1985 p 90-97 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16748*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
ADVANCED THERMAL ENERGY MANAGEMENT: A THERMAL TEST BED AND HEAT PIPE SIMULATION
Ronald G. Barile *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

N87-16757*# Tennessee Univ. Space Inst., Tullahoma.
COMPUTATION OF NOZZLE FLOW FIELDS USING THE PARC2D NAVIER-STOKES CODE
Frank G. Collins *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

N87-16779*# Memphis State Univ., Tenn. Dept. of Mechanical Engineering.
SHARPLY CURVED TURN AROUND DUCT FLOW PREDICTIONS USING SPECTRAL PARTITIONING OF THE TURBULENT KINETIC ENERGY AND A PRESSURE MODIFIED WALL LAW
L. Michael Santi *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 37 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N87-16263# Duke Univ., Durham, N. C.
HOLOGRAPHIC PROPERTIES OF DMP-128 PHOTOPOLYMERS Final Report, 15 Nov. 1985 - 31 Dec. 1986
B. D. Guenther and William Hay 5 Sep. 1986 49 p
(Contract DAAL03-86-C-0005)
(AD-A172825; ARO-23204.1-PH) Avail: NTIS HC A03/MF A01 CSCL 14/5

Ever since the discovery of the principles of wavefront reconstruction (orholography) in 1948, efforts have been made to improve the quality of the reconstructed holographic image. In the early 60's, the performance of holography was improved by using separate object and reference beams. The invention of the laser shortly thereafter spurred increased research activity in holography as more powerful coherent sources made quality images practicable. As in most developing technologies, a major field of continuing interest is the search for better materials. This thesis is dedicated to the characterization of a promising new development in holographic recording materials: Polaroid's DMP-128 holographic recording system. GRA

N87-16264# Geo-Centers, Inc., Newton, Mass.
NON-INVASIVE ELECTRO-MAGNETIC FIELD SENSOR Final Report, May 1985 - May 1986
Bruce N. Nelson, Christoph Menzel, and Thomas G. DiGuisseppe Jan. 1986 94 p
(Contract F33615-85-3417)
(AD-A173683; GC-TR-578-01; AFWAL-TR-86-3051) Avail: NTIS HC A05/MF A01 CSCL 14/2

The development of a non-invasive electromagnetic field sensor that would not perturb the electric field being measured was investigated. Electro-optic crystals were selected such that a difference in the index of refraction along the optical axes would result in a change in transmission through the optical system when an electric field was applied. Through the choice of appropriate crystals and crystal geometries, various sensitivities and ac bandwidths are attained in a fiber optic sensor. The electro-optic effect exhibited in electro-optic crystals is sensitive to an electric field in only one direction. A sensor can be developed using multiple

crystals mounted orthogonally that can measure both the strength and direction of the electric field. The electronics and signal processing equipment can be located a great distance from the sensor allowing for real time electric field measurements in hostile environments. This phase of research was directed towards selecting suitable electro-optic crystals for the design of such a sensor and towards determining the optimum means of signal detection. GRA

N87-16265# Army Research Inst. of Environmental Medicine, Natick, Mass.
EVALUATION OF INSULATED MINIATURE THERMISTORS FOR SKIN TEMPERATURE MEASUREMENT IN THE RAT
Patricia C. Szlyk, Ingrid V. Sils, June D. Ferguson, William T. Matthew, and Roger W. Hubbard Aug. 1986 28 p
(AD-A174184; USARIEM-T-19-86) Avail: NTIS HC A03/MF A01 CSCL 06/3

A miniature thermistor modified by covering its outer surface with insulating foam was evaluated as a temperature sensor at three skin sites in the adult male laboratory rat. A high precision thermistor was modified by covering the outer epoxy surface with about 1/4 inch of a commercially available insulating foam. Such foam thickness provided sufficient insulation to reduce the influence of ambient temperature on the thermistor reading yet contributed minimal additional probe weight. Results indicate that compared to the insulated thermistor, the uninsulated probe underestimated skin temperature measured at the midscapular region of the back, ventral surface of the foot, and dorsal base of the tail at cool ambient temperature (25c) and overestimated temperature at the back and tail skin sites at high ambient temperature (42c). The differences in temperature measured by the insulated and uninsulated thermistors were greastest at the back skin site, which was the only fur-covered and the least vascularized area of the rat that we studied. Using an insulated miniature thermistor to reduce the influence of environmental temperature on thermistor readings when measuring skin temperature in a furred laboratory animal is recommended. GRA

N87-16266# Stanford Univ., Calif. Dept. of Computer Science.
ON DETECTING EDGES
Vishvjit S. Nalwa and Thomas O. Binford Mar. 1986 51 p
(Contract N00039-84-C-0211)
(AD-A174185; STAN-CS-86-1130) Avail: NTIS HC A04/MF A01 CSCL 14/5

An edge in an image corresponds to a discontinuity in the intensity surface of the underlying scene. It can be approximated by a piecewise straight curve composed of edgels, i.e., short, linear edge elements, each characterized by a direction and a position. The approach to edgel-detection here, is to fit a series of one-dimensional surfaces to each window (kernel of the operator) and accept the surface description which is adequate in the least squares sense and has the fewest parameters. (A one-dimensional surface is one which is constant along some direction.) The tanh is an adequate basis for the step edge and its combinations are adequate for the roof edge and the line edge. The proposed method of step edgel detection is robust with respect to noise; for (step size / sigma sub noise) > or = 2.5, it has subpixel position localization (sigma sub position < 1/3) and an angular localization better than 10 deg; further, it is designed to be insensitive to smooth shading. These results are demonstrated by some simple analysis, statistical data and edgel-images. Also included is a comparison, of performance on a real image, with a typical operator (Difference of Gaussians). The results indicate that the proposed operator is superior with respect to detection, localization and resolution. GRA

N87-16027*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSOR TECHNOLOGY FOR ADVANCED SPACE MISSIONS
N. M. Nerheim and R. P. DePaula *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 207-219 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 14B

N87-16190# Joint Publications Research Service, Arlington, Va.
MOTION OF GYROSCOPE WITH LOW SELF-EXCITATION
M. L. Pivovarov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 45 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 23-27 Original language document was announced in IAA as A86-24282 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

N87-16191# Joint Publications Research Service, Arlington, Va.
ACCELERATION OF CONTACTLESS GYROSCOPE IN RESISTANT MEDIUM
S. F. Kudin and Yu. G. Martynenko *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 46 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 14-22 Original language document was announced in IAA as A86-24281 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

N87-16192# Joint Publications Research Service, Arlington, Va.
INTEGRATION OF EQUATIONS OF MOTION OF GYROCOMPASS
R. Kh. Bashirov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 46-47 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 3-13 Original language document was announced in IAA as A86-24280 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

N87-16173# Joint Publications Research Service, Arlington, Va.
NEW CAMERA BASED ON LASER RADIATION DEVELOPED
In its USSR Report: Engineering and Equipment 13 Aug. 1986 p 59 Transl. into ENGLISH from Tass International Service (Moscow, USSR), 28 Feb. 1986 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

N87-16328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHUTTER MECHANISM FOR CALIBRATION OF THE CRYOGENIC DIFFUSED INFRARED BACKGROUND EXPERIMENT (DIRBE) INSTRUMENT
Allen Tyler *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 97-102 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 14B

N87-16752*# DePauw Univ., Greencastle, Ind. Dept. of Physics and Astronomy.
QUANTITATIVE SCHLIEREN ANALYSIS APPLIED TO HOLOGRAMS OF CRYSTALS GROWN ON SPACELAB 3
Howard L. Brooks *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14E

N87-16756*# Marshall Univ., Huntington, W. Va. Dept. of Chemistry.
DEVELOPMENT OF PASSIVE RADIATION DETECTORS OF IMPROVED SENSITIVITY
M. R. Chakrabarty *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

N87-16782*# Alabama Univ., Huntsville. Dept. of Physics.
AUTOMATED CALIBRATION OF A FLIGHT PARTICLE SPEC-

TROMETER
Roy B. Torbert *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 12 p (For primary document see N87-16742 06-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N87-16267# Litton Systems, Inc., Morris Plains, N. J. Airtron Div.
INVESTIGATION OF SINGLE CRYSTAL SILICATES FOR BLUE TUNABLE LASERS Quarterly Report, 1 Dec. 1985 - 28 Feb. 1986
R. F. Belt and J. A. Catalano Jun. 1986 29 p
(Contract N00014-85-C-0823)
(AD-A171823; QR-2) Avail: NTIS HC A03/MF A01 CSCL 20/6

The single crystal growth of rare earth silicates was investigated for the purpose of tunable laser hosts. Silicates of the type R2Si05, where R = La, Gd, Y, were prepared from stoichiometric melts and doped with Ce3+ activators. Seed crystals were obtained from crystallized melt sections or by growth on an iridium wire. Cathodoluminescence experiments on both powders and single crystals showed wavelength shifts with different rare earth ions. The Gd, Y, and mixed crystals of Gd-Y silicates gave good bright emission with Ce3+. The emission is broad band and covers the wavelength range of 370 to 525 micron. The peak emission can be centered near 450 to 460 micron by other compositions. Larger single crystals for laser hosts are under development.
Author (GRA)

N87-16268# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
PULSED LASER PROCESSES ON SURFACES: FORMATION OF STRUCTURAL DEFECTS, MEASUREMENT OF SURFACE DIFFUSION AND DIRECT DETECTION OF REACTION INTERMEDIATES Final Report, 1 Jul. - 31 Dec. 1985
Peter C. Stair 7 Feb. 1986 5 p
(Grant AF-AFOSR-0199-84)
(AD-A172050; AFOSR-86-0739TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

Research Projects Making Use of the Above Equipment included are: The Role of Surface Structural Defects in Surface Chemistry; The Formation and Surface Chemistry of Laser Induced Defects; The Nature of Catalytically Active Surfaces; and The Mechanism of Lubricant Film Breakdown. GRA

N87-16269 Department of the Air Force, Washington, D.C.
CW (CONTINUOUS WAVE) HF R-BRANCH LASER Patent
Hagop Injeyan, inventor (to Air Force) and John H. Wang, inventor (to Air Force) Issued 1 Jul. 1986 6 p Supersedes US-Patent-Appl-SN-583026
(AD-D012517; US-Patent-4,598,409; US-Patent-Appl-SN-583026; US-Patent-Class-372-89) Avail: US Patent and Trademark Office CSCL 20/5

A continuous wave HF R-branch chemical laser uses a linear array nozzle system having primary and secondary nozzles for exciting HF and a laser resonator having mirrors with reflectance to discriminate against P-branch lasing of the excited Hydrogen Fluoride. Author (GRA)

N87-16270# Berkeley Research Associates, Inc., Calif.
FREE ELECTRON LASER THEORY Final Report, 1 May 1985 - 30 Apr. 1986
W. B. Colson 10 Jul. 1986 98 p
(Contract F49620-85-C-0087)
(AD-A172996; BRA-86-313R; AFOSR-86-0912TR; FR-4) Avail: NTIS HC A05/MF A01 CSCL 20/5

Free electron laser (FEL) theory is extended to explain several effects associated with high gain operation. The trapped particle instability is reviewed for short pulses FELs, FEL oscillators, and FEL amplifiers. A new FEL theory exactly includes the effect of an arbitrary electron distribution function and an explanation is given for optical self guiding. GRA

N87-16271# Defence Research Establishment Valcartier (Quebec).
MULTIPLE-SCATTERING LASER PROPAGATION MODEL AND COMPARISON WITH LABORATORY MEASUREMENTS
L. R. Bissonette Sep. 1986 46 p
(AD-A172610; DREV-R-4422/86) Avail: NTIS HC A03/MF A01 CSCL 20/6

A multiple scattering laser propagation model is developed in the form of three simultaneous partial differential equations for the reduced field amplitude, the forward and the backscattered irradiances. The scattering and diffusion coefficients are defined in terms of Mie functions, and reduction factors are derived to take into account detection at limited fields of view. Solutions for transmitted beam profiles and integrated backscatter are compared with measurements performed on laboratory generated water droplet clouds at 0.63, 1.06 and 10.6 micrometer. The agreement is very good for all conditions investigated, ranging from negligible to important multiple-scattering contributions. GRA

N87-16272# Naval Research Lab., Washington, D. C.
USE OF INCOHERENCE TO PRODUCE SMOOTH AND CONTROLLABLE IRRADIATION PROFILES WITH KrF FUSION LASERS
R. H. Lehmberg and J. Goldhar 14 Aug. 1986 21 p
(Contract DE-AI08-79DP-40092)
(AD-A172612; NRL-MR-5829) Avail: NTIS HC A02/MF A01 CSCL 20/5

A technique called Echelon Free Induced Spatial Incoherence, is proposed for producing smooth, controllable target beam profiles with large KrF fusion lasers. The idea is basically an image projection technique that projects the desired time averaged spatial profile F(x) onto the target via the laser system, using partially-coherent broadband light. The information needed to reproduce F(x) is transported through the system by a multitude of independent coherence zones, whose diameters are small in comparison to scale length of linear aberration and gain nonuniformities; as a result, F(x) remains relatively insensitive to these effects. This concept is closely related to the Induced Spatial Incoherence (ISI) technique used with glass lasers, except that it does not require echelons at the output of the system. An analysis is carried out to evaluate the perturbations of F(x) due to linear aberration, self-focusing, gain saturation, and diffraction. It shows that under conditions applicable to large KrF lasers, the perturbations will result in a small broadening and smoothing of F(x), whose functional form should be controllable to within a few percent. The ability of this technique to generate smooth focal profiles is demonstrated using a small KrF discharge oscillator preamplifier system. GRA

N87-16273# Florida Univ., Gainesville. Dept. of Chemistry.
PHOTODISSOCIATION OF GASEOUS IONS FORMED BY LASER DESORPTION Technical Report, 1 Jun. 1985 - 1 Jul. 1986
Clifford H. Watson, Gokhan Baykut, and John R. Eyler 20 Sep. 1986 29 p
(Contract N00014-82-K-0509)
(AD-A172621; TR-6) Avail: NTIS HC A03/MF A01 CSCL 20/5

Both pulsed and gated continuous wave carbon dioxide lasers have been employed to desorb ions and then to photodissociate them in a Fourier transform ion cyclotron resonance mass spectrometer. Pulsed CO2 laser irradation was most successful in laser desorption experiments, while a gated continuous wave laser was used for a majority of the successful infrared multiphoton dissociation studies. Fragmentation of ions with m/z values in the range 400 to 1300 was induced by infrared multiphoton dissociation. Such photodissociation was successfully coupled with laser desorption for a number of different classes of compounds. Either two sequential pulses from a pulsed carbon dioxide laser (one for desorption and one for dissociation) or one

desorption pulse followed by gated continuous wave irradation to bring about dissociation were ultilized. GRA

N87-16274# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MULTIPIXEL, MULTIDIMENSIONAL LASER RADAR SYSTEM PERFORMANCE Ph.D. Thesis
Martin B. Mark Aug. 1986 142 p
(AD-A172841; AFIT/CI/NR-86-172D) Avail: NTIS HC A07/MF A01 CSCL 17/9

Laser radar analyses up to now generally fall into two categories. Single pixel analyses exist which cover receiver design, target statistics, atmospheric effects, and the resulting statistical performance characterizations like probabilities of detection (PD) and false alarm (PF). Multipixel analyses exist which use various ad HOC target recognition, identification, and feature extraction schemes based on intuitive insight or analogies to human perception. The limitation of these multipixel processors is it is difficult to quantitatively predict processor performance as a function of various system parameters and the resolving power in the measurement dimensions like range, Doppler shift, and angle. The single pixel performance equations can give quantitative answers to these questions, but only for single pixel measurements. This thesis bridges these two approaches by proposing physically realistic target, background, and radar models which allow us to incorporate the statistics for the single pixel measurements into multipixel probability density functions and derive quais-optimal generalized likelihood ratio processors from the densities. GRA

N87-16275# Air Force Weapons Lab., Kirtland AFB, N. Mex.
ELECTRIC DISCHARGE COAXIAL LASER POWER MEASUREMENT Final Report, 20 May - 1 Jun. 1985
Arnold L. Augustoni Sep. 1986 28 p
(AD-A173725; AFWL-TN-85-46) Avail: NTIS HC A03/MF A01 CSCL 20/5

This report presents a theoretical and empirical treatment of the power-measuring techniques used in determining the output power of the Electric Discharge Coaxial Laser (EDCL). Errors in power measurement associated with the diagnostic beam splitter were investigated. These areas included errors associated with the removal of the beam splitter for storage overnight and the repositioning of the beam splitter the following day, and the introduction of possible errors as a result of interference between the beams reflected from the front and rear surfaces of the beam splitter. Author (GRA)

N87-16276# Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Md.
LASER SYSTEMS, AIRBORNE Final Report
11 Sep. 1986 41 p Supersedes MTP-6-E-166
(AD-A173775; TOP-6-3-166; MTP-6-E-166) Avail: NTIS HC A03/MF A01 CSCL 19/5

This TOP describes tests for measuring and evaluating the capabilities of airborne laser systems in an airborne environment. It describes test procedures for testing range accuracy, target resolution, target illumination, communications systems, and substitute laser systems. GRA

N87-16277# New Mexico Univ., Albuquerque.
MECHANISMS OF PULSED LASER INDUCED DAMAGE TO OPTICAL COATINGS Final Report
Michael R. Lange Jul. 1986 136 p
(Contract F29601-84-K-0092)
(AD-A174194; AFWL-TR-86-36) Avail: NTIS HC A07/MF A01 CSCL 20/5

Laser induced damage in optical components is the limiting factor in the design of high power lasers. This problem is addressed with special emphasis placed on the optical coatings used on the components. A theoretical model is developed assuming basic mechanisms which lead to damage of the coatings. Numerical results are generated and compared with experimental data. The basic procedure applied is that of the solution of inhomogenous field equations representing classical heat and electron diffusion in solids. The technique used is integral transform mathematics. Results are supported by modeling with a numerical finite element program. Findings include several sets of scaling relations which give insight into the relationship of the damage threshold of optical coatings to the material and laser parameters involved. These are plotted against experimental data for support of the assumed processes. These findings include the fact that the rate at which thermal diffusion occurs in optical components is important, and that there is a fundamental difference in the damage process between oxide and fluoride coatings. In addition, basic mechanisms are suggested as the source of damage in these coatings. GRA

N87-16278# Hughes Research Labs., Malibu, Calif.
COHERENT LASER SCALING USING OPTICAL PHASE CONJUGATION Interim Report, Sep. 1985 - Sep. 1986
G. C. Valley, J. O. White, and R. A. McFarlane Nov. 1986 73 p
(Contract N00014-85-C-0534)
(AD-A174280) Avail: NTIS HC A04/MF A01 CSCL 20/6

Coherent combining of pulsed dye gain media through phase conjugation in photorefractive barium titanate is reported. Phase and frequency locking of two and three pulsed dye lasers is demonstrated for both narrowband cavities (0.05 nm) and broadband cavities (0.25 nm). Oscillator configurations are used throughout in order to avoid geometries that require a master oscillator or a master laser and slave laser. GRA

N87-16279# Dartmouth Coll., Hanover, N.H. Dept. of Physics and Astronomy.
HIGH POWER, MILLIMETER-WAVELENGTH, COHERENT RADIATION SOURCES Final Report, 1 Feb. 1982 - 31 Jan. 1986
John E. Walsh 25 Sep. 1986 72 p
(Grant AF-AFOSR-0168-82)
(AD-A174521; Rept-86-0168; AFOSR-86-1089TR) Avail: NTIS HC A04/MF A01 CSCL 20/5

A summary of the results of the Cerenkov Maser development is presented. During the course of this work, operation over the spectral range extending from just below 30 GHz to just above 300 GHz was demonstrated. Sources based upon high-power microwave-tube technology and sources driven by pulse-power generators were both used to drive Cerenkov Masers. In the former type, 10% efficiency from single-pass, untapered resonators were obtained, while in the latter, efficiency was in the 0.1 to 1% range. Extensive computer codes describing linear and nonlinear aspects of Cerenkov Master operation were also developed. GRA

N87-16280# Lawrence Livermore National Lab., Calif.
ASPECTS OF RAMAN SCATTERING AND OTHER EFFECTS ON LASER PROPAGATION THROUGH THE ATMOSPHERE Summary Report, 5 May - 13 Jun. 1986
J. R. Ipser Aug. 1986 17 p
(Contract W-7405-eng-48)
(DE86-015152; UCID-20846) Avail: NTIS HC A02/MF A01

The propagation of laser beams through the atmosphere is discussed. Processes which are pertinent are Raman scattering, self-focusing of beams, and two-photon absorption. Comments on the subroutine PRAMAN are given in the appendix. This subroutine calculates the effect of stimulated Raman scattering in the atmosphere. DOE

N87-16281# Academy of Sciences, Dresden (East Germany). Zentralinstitut fuer Optik und Spektroskopie.
ABSTRACTS OF THE 5TH INTERNATIONAL CONFERENCE ON LASERS AND THEIR APPLICATIONS
1985 219 p Conference held in Dresden, East Germany, 28 Oct. 1985 Prepared in cooperation with Physikalische Gesellschaft der DDR, Berlin
(DE86-703284; INIS-mf-10401; CONF-851024-Absts) Avail: NTIS (US Sales Only) HC A10/MF A01

Results were presented in the fields of laser physics and laser applications including the development of laser light sources, laser frequencies in the UV and VUV spectral regions using anti-Stokes Raman scattering, nonlinear optical effects for the formation of ultrashort optical pulses, laser spectroscopy, collisionless multipho-

ton excitation processes using molecular beams, selective generation of free radicals by laser, laser applications in medicine, plasma diagnostics analyzing X-ray spectra for studying laser fusion problems, coherence properties in phase-sampling interferometric techniques, and fundamental problems in quantum physics and nonlinear processes. DOE

N87-16282# Los Alamos National Lab., N. Mex.
BENDING AND FOCUSING EFFECTS IN AN FEL OSCILLATOR. PART 2: NUMERICAL SIMULATIONS
B. D. McVey and R. W. Warren Sep. 1986 21 p Presented at the 8th International Free Electron Laser Conference, Glasgow, Scotland, 1 Sep. 1986
(Contract W-7405-eng-36)
(DE86-015315; LA-UR-86-2951; CONF-8609131-2) Avail: NTIS HC A02/MF A01

Bending and focusing of the optical beam by the electron beam is investigated for an FEL oscillator configuration. Numerical calculations are performed with the simulation code, FELEX. DOE

N87-16283# Lawrence Livermore National Lab., Calif.
AUTOMATIC ADJUSTABLE LASER OSCILLATOR
A. Fujimura Aug. 1986 18 p Transl. into ENGLISH of Japanese Patent No. Sho 591984-50588
(Contract W-7405-eng-48)
(DE87-000103; UCRL-Trans-12106) Avail: NTIS HC A02/MF A01

A laser oscillator is characterized by the fact that on the periphery of one of its optical wave oscillator mirrors the movable ends of three or four piezoelectric elements are fixed, the other end of each piezoelectric element being immovable, and there is an electronic circuit that can change the voltage combination appled on these piezoelectric elements, with the laser output being detected by a photoelectric element. The electronic circuit is deigned to find the best combination of voltages applied on the piezoelectric elements that correspond to the maximum output of the laser light. DOE

N87-16284# Los Alamos National Lab., N. Mex.
LARGE EXCIMER LASERS FOR FUSION
R. J. Jensen 1986 14 p Presented at the Society of Photo-Optical Instrumentation Engineers Conference, Bellingham, Wash., 14 Sep. 1986
(Contract W-7405-eng-36)
(DE87-000164; LA-UR-86-3319; CONF-8609162-1) Avail: NTIS HC A02/MF A01

Important goals in DOE and DOD programs require multimegajoule laser pulses. For inertial confinement fusion there is also a requirement to deliver the pulse in about 25 nsec with a very particular power vs time profile - all at high overall efficiency and low cost per joule. After exhaustive consideration of various alternatives, studies have shown that the most cost effective approach to energy scaling is to increase the size of the final amplifiers up to the 200 to 300 kJ level. This conclusion derives largely from the fact that, at a given complexity, costs increase slowly with increasing part size while output energy should increase dramatically. Extrapolations to low cost by drastic cuts in the unit cost of smaller devices through mass production are considered highly risky. At a minimum the requirement to provide space, optics and mounts for such systems will remain expensive. In recent years there have been dramatic advances in scaling. The Los Alamos LAM has produced over 10 kJ in a single 1/2 nsec pulse. In this paper we explore the issues involved in scaling to higher energy while still maintaining high efficiencies. In the remainder of this paper we will discuss KrF laser scaling for the fusion mission. We will omit most of the discussion of the laser system design, but address only KrF amplifiers. DOE

N87-16285# Sandia National Labs., Albuquerque, N. Mex.
DESIGN OF A 10.6 MICRON LASER RADAR TRANSMITTER
W. D. Williams Sep. 1986 30 p
(Contract DE-AC04-76DP-00789)
(DE87-000675; SAND-86-0028) Avail: NTIS HC A03/MF A01

The analysis and design of a 10.6 micron laser radar transmitter is reviewed. This laser radar will serve as a testbed for the development of electrooptic componentry and image recognition software. A number of design problems are defined by the performance constraints. These design problems are analyzed with first-principles modeling and a set of expected performance attributes is determined. The resulting design is discussed in detail and, where possible, commercially available hardware is identified for use in the laser radar design. DOE

N87-16286# California Univ., Berkeley. Lawrence Berkeley Lab.
DEVELOPMENT AND APPLICATION OF A HIGH POWER, BROADLY TUNABLE, PICOSECOND SOURCE Ph.D. Thesis
H. Nathel Jun. 1986 316 p
(Contract DE-AC03-76SF-00098)
(DE87-000935; LBL-20446) Avail: NTIS HC A14/MF A01

The development of pulsed, active/passive, mode-locked, Nd:YAG laser system is described in detail. The careful design and construction of the system resulted in very reliable and stable operation. A full appreciation for the mode-locking process aided in the understanding of important factors that contributed to the excellent performance of the system, especially the implementation of active mode-locking. Transform-limited behavior was attained. Pulse shortening was discovered with pulses as short as 2 to 3 ps being measured. The corresponding spectral bandwidths were between 6.0 and 6.5/cm. These pulses are at or near the Fourier transform-limit for Gaussian pulses and are the shortest pulses ever observed from a mode-locked Nd:YAG laser without external pulse compression techniques being employed. Taking advantage of the high peak powers attainable from the laser system, a simple third harmonic (355nm) pumped, single pass, traveling wave, optical parametric source (OPS) was constructed in order to extend the tunability of such a system across nearly the entire visible and near infrared spectral regions. The OPS was used to study the wavelength dependence of rotational reorientation dynamics of rhodamine 6G (R6G) in ethanolic solutions using picosecond time-resolved, fluorescence depolarization techniques. It was determined that wavelength had no effect on the rotational reorientation dynamics of the system on timescales equivalent to or much less than the rotational lifetime of the solute. DOE

N87-16569# Joint Publications Research Service, Arlington, Va.
SINGLE CRYSTALS OF ZnSe(1-x)Te(x), Zn(1-x)Cd(x)Se, Zn(x)Cd(1-x)S SOLID SOLUTIONS FOR LASERS WITH ELECTRON-BEAM PUMPING Abstract Only
A. M. Akhekyan, V. I. Kozlovskiy, Yu. V. Korostelin, A. S. Nasibov, Yu. M. Popov, and P. V. Shapkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 3 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1113-1115 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16571# Joint Publications Research Service, Arlington, Va.
SPECTRAL AND TEMPORAL CHARACTERISTICS OF HIGH-POWER NEODYMIUM GLASS LASER EMPLOYING CASCADE FREQUENCY CONVERSION IN VACUUM ULTRAVIOLET REGION Abstract Only
Yuriy Vasilyevich Korobkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 24 Transl. into ENGLISH from the mono. "Spektralnyye i Vremennyye Kharakteristiki Moshchnogo Lazera na Neodimovom Stekle s Kaskadny, Preobrazovaniyem Chastoty v Oblast Vakuumnogo Ultrafioleta" Moscow, USSR, 1984 p 3-20 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16572# Joint Publications Research Service, Arlington, Va.
MECHANISM LIMITING OPTIMUM EMISSION PULSE REPETITION RATE OF LASERS ON SELF-LIMITED TRANSITIONS IN METAL VAPORS Abstract Only
P. A. Bokhan *In its* USSR Report: Physics and Mathematics (JRPS-UPM-86-007) 23 May 1986 p 26 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May

1985 p 945-952 Original language document was announced in IAA as A85-43302 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16573# Joint Publications Research Service, Arlington, Va.
CONTROLLING SPIKE EMISSION MODE OF TWO-COMPONENT HETEROSTRUCTURE LASER Abstract Only
I. S. Goldobin, V. N. Lukyanov, A. F. Solodkov, and S. D. Yakubovich *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 27 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 3, May 1985 p 953-958 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16574# Joint Publications Research Service, Arlington, Va.
EFFECT OF PARAELECTRODE PROCESSES ON CONTRACTION OF SPACE CHARGE IN PERIODIC-PULSE LASERS Abstract Only
R. V. Arytyunyan, V. Yu. Baranov, V. M. Borisov, A. Yu. Vinokhodov, and Yu. B. Kiryukhin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 28 Transl. into ENGLISH from Kvantovaye Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 971-976 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16575# Joint Publications Research Service, Arlington, Va.
ACTIVATED LiF CRYSTALS AS NOVEL ACTIVE MEDIA FOR TUNABLE LASERS Abstract Only
I. A. Parfianovich, V. M. Khulugurov, N. A. Ivanov, A. A. Mikhalenko, V. A. Chepurnoy, and A. P. Shkadarevich *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 46 Transl. into ENGLISH from the book "Perestraivayemyye po Chastote Lazery" Novosibirsk, USSR, 1984 p 98-104 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16576# Joint Publications Research Service, Arlington, Va.
NARROWING AND SHIFTING EMISSION LINE OF DYE LASER BY MEANS OF IODINE VAPOR ATTACHMENT Abstract Only
V. A. Alekseyev, B. A. Konstantinov, T. I. Mikhalina, B. F. Trinchuk, N. G. Ustinov, and A. V. Shulenin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 47-48 Transl. into ENGLISH from the book "Perestraivayemyye po Chastote Lazery" Novosibirsk, USSR, 1984 p 349-351 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16577# Joint Publications Research Service, Arlington, Va.
POSSIBILITY OF CONTROLLING LASER RADIATION BY MEANS OF STIMULATED MANDELSHTAM-BRILLOUIN SCATTERING IN OPTICAL FIBER Abstract Only
Ye. A. Kuzin and M. P. Petrov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 53 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 11, no. 7, 12 Apr. 1985 p 389-393 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16578# Joint Publications Research Service, Arlington, Va.
MAXIMUM GAIN OF MULTISTAGE LASER AMPLIFIER Abstract Only
A. I. Makarov and A. K. Potemkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 71-72 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1054-1058 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16744*# Missouri Univ., Rolla. Dept. of Physics.
INVESTIGATION OF HARD TARGETS FOR CALIBRATION OF A COHERENT DOPPLER LIDAR SYSTEM
Richard Anderson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 32 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N87-16287 Rhode Island Univ., Kingston.
SUBOPTIMAL CONTROL OF A ROBOT MANIPULATOR Ph.D. Thesis
Zeng Hwa Yang 1985 163 p
Avail: Univ. Microfilms Order No. DA8609897

The time suboptimal control problem subject to position state variable constraints and control variable constraints is solved for a rigid n- degree-of-freedom robot manipulator whose end-effector moves from one specified position to another position. The dynamic equations of motion of the manipulator must be known because the moment of inertia of each joint of the robot and the coupling effects must be known before applying the time suboptimal control algorithm. A three degree of freedom robot manipulator is used in chapter 3 to demonstrate the technique. The time suboptimal control simulation results show that at least half the time was reduced for a typical robot manipulator movement over conventional controller. The suboptimal control law is simpler than current optimal control law, and each joint of the robot has one switching point to turn the controlled torques from maximum values to minimum values. A method also has been presented to analyze the kinematics of a robot arm. Two recursive equations of motion for analyzing the dynamics of robot arm have been developed and modifications to existing work have been made. Simulation of joint torques required by a robot for a single position change have been calculated for both methods. A different model of feedforward coupling compensation to the robot arm control system were given earlier. Two control algorithms utilizing fixed gain and variable gain control were studied for step input performance. Both control algorithms with or without coupling compensation have been evaluated. Under coupling compensation, variable gain control has better step input performance than fixed gain control.
Dissert. Abstr.

N87-16288 Virginia Univ., Charlottesville.
NON-ADIABATIC THERMAL EFFECTS IN TILTING PAD AND MULTILOBE JOURNAL BEARINGS Ph.D. Thesis
Josiah Doss Knight 1986 173 p
Avail: Univ. Microfilms Order No. DA8615618

Approximate methods for analyzing the thermal effects in multilobe and tilting pad bearings are presented. Included is the assumption of a second order temperature profile across the lubricant film, a two dimensional series expansion of temperature conduction in the bearing metal, and viscosity variations in the circumferential direction. Predicted temperature distributions are consistent with measurements in two axially grooved bearings. For analysis of tilting pad bearings, a purely radial conduction model for the pad is shown to give comparable results to a two dimensional conduction model. The radial conduction model is used to determine the effects of variation of offset factor, preload and load direction on steady state and dynamic characteristics. Increases in offset factor above 0.5 are shown to decrease the cross-coupled stiffness coefficients while increasing the principal stiffness and damping coefficients in four-pad non-preloaded bearings at light loads. Changes in preload factor from 0.0 to 0.5 result in increases in both principal and cross-coupled stiffness and damping coefficients at light loads. Changes in load direction for a five-pad bearing from on-pad to between-pad loading are shown to have significant effects on the stiffness and damping coefficients.
Dissert. Abstr.

N87-16289 Carnegie-Mellon Univ., Pittsburgh, Pa.
INERTIAL EFFECTS IN TURBULENT FLUID SEALS

Ph.D. Thesis
Paul Allison Beatty 1986 240 p
Avail: Univ. Microfilms Order No. DA8616492

Fluid seals incorporated into high-power turbo-machinery operate at such rotational speeds and with such great pressure differentials that the flow within them is turbulent and nearly adiabatic. This work puts forth a simple and consistent approach for studying such fluid seals including inertial effects which are shown to have a significant influence on their behavior. The simplicity of the flow models developed using this approach makes the investigation of turbulent seals behavior amenable to parametric study. The problems of determining the leakage rate and the stability characteristics of both annular and radial face seals are addressed, inlet pressure loss due to fluid acceleration and sudden flow constriction are taken into account and the possibilities of phase change and choking are fully considered. Trail parametric studies for seals operating under typical conditions are presented and discussed. Finally, a partial verification of the approach is made by comparing theoretical results to existing experimental data for two-phase flow through fine annular spaces. Dissert. Abstr.

N87-16290 ESDU International Ltd., London (England).
INTRODUCTION TO POLYNOMIAL CAM LAWS
Nov. 1986 79 p
(ESDU-86026; ISBN-0-85679-578-X; ISSN-0141-4046) Avail: ESDU

ESDU 86026 gives three methods by which a polynomial equation can be used for a cam law that will satisfy certain motion requirements (displacement, velocity, acceleration, etc.) at specified points. One method uses a single minimum-order polynomial for a complete motion segment in which the number of successive power terms satisfies the number of motion conditions set. A FORTRAN program is included to evaluate the coefficients. A second method is exponent manipulation in which the number of terms is the same as for the minimum-order equation, but the powers now increase in equal steps. Such equations are formulated initially to meet only boundary conditions, but can satisfy precision points. The final approach is blending, in which the motion segment is divided into portions, the intersection of which is chosen at each precision point and on which each portion uses a single minimum-order polynomial. The method of ensuring continuity of motion areas in the intersections is explained. Comprehensive worked examples illustrate and compare the methods. ESDU

N87-16291 ESDU International Ltd., London (England).
EJECTORS AND JET PUMPS. DESIGN FOR STEAM DRIVEN FLOW
Nov. 1986 79 p
(ESDU-86030; ISBN-0-85679-582-8; ISSN-0141-4011) Avail: ESDU

ESDU 86030 gives step-by-step calculation procedures, based on performance charts, for the optimum design of steam/liquid and steam/gas ejectors. For the latter the data are derived from a wide range of experimental results, but for steam/liquid ejectors there were insufficient data and a theoretical anlysis was used. For steam/liquid ejectors a performance prediction method is included which allows off-design behavior to be estimated. Practical examples using the methods illustrate their application. Mechanical design considerations for th.› components (primary nozzle, mixing chamber,contraction oR diff‴user) are described, and the use of annular or multinozzle arrangements is considered. Application by multi-staging is discussed. Operating problems in start-up or shut-down are introduced, together with consideration of instability and noise. Limits imposed by the onset of cavitation and vapor binding are outlined for steam/liquid use. ESDU

N87-16292# Bently Nevada Corp., Minden.
CHARACTERIZATION OF RUB PHENOMENA IN ROTATING MACHINERY
A. Muszynska 1986 5 p
(Rept-18138) Avail: NTIS HC A02/MF A01

Rub in a rotating machine is a malfunction condition associated with the physical contact of rotating and stationary parts which otherwise should not be in contact. The effects of rub related changes in the rotating machine are discussed. The classification of rub locations are summarized. Machine element vibrational response to rub is also described. B.G.

N87-16293 Department of the Air Force, Washington, D.C.
DOUBLE PINCH-PUSH CONTACT INSERTION END-EFFECTOR Patent
Mark S. Weixel, inventor (to Air Force) Issued 8 Jul. 1986 6 p Supersedes US-Patent-Appl-SN-675173
(AD-D012515; US-Patent-4,598,469; US-Patent-Appl-SN-675173; US-Patent-Class-29-747) Avail: US Patent and Trademark Office CSCL 13/9

A double pinch-push contact insertion end-effector for performing contact insertion on a universal basis is described. The end-effector comprises a front jaw assembly. Each jaw assembly comprises a pair of jaws, where each pair is individually actuable to effect contact insertion. Author (GRA)

N87-16294 Department of the Air Force, Washington, D.C.
VIBRATION ISOLATOR ACTUATOR FOR A SEGMENTED MIRROR Patent
Roland L. Plante, inventor (to Air Force) and Austin L. McKenney, inventor (to Air Force) Issued 22 Jul. 1986 6 p Supersedes US-Patent-Appl-SN-690438
(AD-D012525; US-Patent-4,601,554; US-Patent-Appl-SN-690438) Avail: US Patent and Trademark Office CSCL 13/7

A novel actuator for controlling the position of a mirror segment of a segmented mirror assembly and for isolating the segment from vibration is described, which comprises a movable control member operatively interconnecting the segment and support structure for the mirror assembly; an actuator assembly, which may comprise an electrically controlled magnet and coil, operatively attached to the control member and responsive to an input signal, for moving the control member to selectively position the mirror segment relative to the support structure; a force amplifier connected to one or both ends of the control member for amplifying the force exerted on the control member, and which may be in the form of a pair of cooperating fluid filled bellows of different sizes coaxially disposed at one or both ends of the control member so that compression of the smaller bellows communication with the larger bellows results in an amplification of the force imposed on the control member; a position sensor for sensing the position of the control member and providing a corresponding output signal; and programmable electronics for processing the output signal of the position sensor and providing the input signal to the actuator per preprogrammed scheme. GRA

N87-16295# Naval Postgraduate School, Monterey, Calif.
COMPUTER SIMULATION AND EXPERIMENTAL VALIDATION OF A DYNAMIC MODEL (EQUIVALENT RIGID LINK SYSTEM) ON A SINGLE-LINK FLEXIBLE MANIPULATOR M.S. Thesis
Robert P. Petroka Jun. 1986 92 p
(AD-A174171) Avail: NTIS HC A05/MF A01 CSCL 09/2

Flexibility effects on robot manipulator design and control are typically ignored, which is justified when large, bulky robotic mechanisms are moved at slow speeds. However, when increased speed and improved accuracy is desired in robot system performance it is necessary to consider flexible manipulators. This project simulates the motion of a single-link, flexible manipulator using the Equivalent Rigid Link System dynamic model and experimentally validates the computer simulation results. Validation of the flexible manipulator dynamic model is necessary to ensure confidence in the model for use in future design and control applications of flexible manipulators. GRA

N87-16296# Computational Mechanics Consultants, Austin, Tex.
COMPUTATIONAL METHODS FOR NONLINEAR DYNAMICS PROBLEMS IN SOLID AND STRUCTURAL MECHANICS: MODELS OF DYNAMIC FRICTIONAL PHENOMENA IN METALLIC STRUCTURES Final Report, 1 Feb. 1984 - 1 Feb. 1986
J. T. Oden 31 Mar. 1986 343 p

(Contract F49620-84-C-0024)
(AD-A174585; TR-86-02; AFOSR-86-2015TR) Avail: NTIS HC A15/MF A01 CSCL 20/11

In this report the dynamic behavior of metallic bodies subjected to dry frictional contacts is studied. A simple model of interface response which incorporates a constitutive equation for the normal deformability of the interface and the Coulomb law of friction is developed. This interface model is incorporated in the formulation of problems in continuum mechanics that invlove the contact of linearly elastic or viscoelastic bodies. Variational formulations for these problems are established and existence and uniqueness results are proved for steady-sliding and dynamic frictionless or frictional contact problems. The same interface model is also incorporated in finite dimensional models for contact problems: a simple rigid body model and finite element space discretizations of the continuum models. Numerical studies steady sliding and its dynamic stability are presented, as well as numerical studies of friction-induced oscillations. In the latter case, the Newmark method and the central-difference technique are used to integrate numerically the equations of motion. In the numerical studies particular emphasis is given to the role played by normal degree-of-freedom in frictional sliding. GRA

N87-16297# Sandia National Labs., Albuquerque, N. Mex.
CHARACTERIZATION OF ACCELEROMETER MOUNTINGS IN SHOCK ENVIRONMENTS
V. I. Bateman and O. M. Solomon, Jr. Aug. 1986 42 p
(Contract DE-AC04-76DP-00789)
(DE86-014941; SAND-86-1606) Avail: NTIS HC A03/MF A01

This report describes the shock test characterization of four accelerometer mounting techniques which are: adiprene and wax, polysulfide rubber and wax, restrained adiprene, and hard mount. The mountings have all been used in field tests, and the shock testing provides some simulation of the field test environments. The characteristics of these mountings are analyzed in the time-domain and in the frequency-domain and are compared to the response of a reference accelerometer at two different shock levels, approximately 2 kg and 7 kg. While soft mounting techniques can be used to guarantee acceleratometers survival in severe mechanical environments, this report documents the tested mounting materials to be highly nonlinear. These nonlinearities result in significant data distortion at frequencies above a few hundred hertz. DOE

N87-16298# California Univ., Berkeley. Lawrence Berkeley Lab.
MICROSTRUCTURAL REFINEMENT THROUGH MULTIPASS GTAW PROCESS
H. J. Kin and J. W. Morris, Jr. Apr. 1986 16 p Presented at the ASM International Trends in Welding Research Meeting, Gatlinburg, Tenn., 18 May 1986
(Contract DE-AC03-76SF-00098)
(DE86-015134; LBL-21354; CONF-860594-10) Avail: NTIS HC A02/MF A01

The present work was undertaken to illustrate and clarify the microstructural features of martensitic Fe-Ni weld deposits made by a multipass welding process. To simulate this, rapid thermal treatments were applied to an Fe-12Ni-0.25Ti alloy using an induction furnace and bead-on-plate welding. The rapid thermal treatment refines the microstructure significantly by destroying the previous packet structure. Hence, the term packet refinement is used to distinguish its microstructural features from the grain refinement associated with recrystallization of austenite. During multipass GTAW process with an 11% Ni ferritic filler wire, a coarse columnar grain structure is formed after solidification but this structure is refined repetitively by the rapid thermal cycles of subsequent passes. The result is a fully packet refined and extremely fine structure, in the order of several microns, throughout the weldment. DOE

N87-16299# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
IMPROVEMENT OF FUSION WELDING THROUGH MODELING, MEASUREMENT AND REAL-TIME CONTROL Technical Report, 1 Nov. 1984 - 31 May 1986
K. Masubuchi, D. E. Hardt, and W. C. Unkel 25 Aug. 1986 8 p
(Contract DE-AC02-83ER-13084)
(DE86-015552; DOE/ER-13084/1) Avail: NTIS HC A02/MF A01

The objective of this research program is to improve the quality of welds through modeling, and measurement and real-time control. The program has been carried out through cooperative efforts by Professors Hardt, Masubuchi and Unkel. DOE

N87-16300# Eaton Corp., Southfield, Mich. Engineering and Research Center.
DIRECT INJECTION OF HIGH-PRESSURE NATURAL GAS IN RECIPROCATING ENGINES Final Topical Report, Nov. 1984 - 28 Feb. 1986
L. O. Hoppie Aug. 1986 91 p
(Contract GRI-5084-243-1003)
(PB87-102133; GRI-86/0129) Avail: NTIS HC A05/MF A01 CSCL 21A

Developments of an injection system and combustion process, which will permit a natural gas fueled engine to have a shaft efficiency as high as the shaft efficiency of the equivalent diesel engine are discussed. GRA

N87-16301# Eaton Corp., Southfield, Mich. Engineering and Research Center.
DIRECT INJECTION OF HIGH-PRESSURE NATURAL GAS IN RECIPROCATING ENGINES, APPENDICES Final Report, Sep. 1984 - Jan. 1986
L. O. Hoppie Aug. 1986 70 p
(Contract GRI-5084-243-1003)
(PB87-116265; GRI-86/0129.1) Avail: NTIS HC A04/MF A01 CSCL 20A

Various conventional approaches to igniting directly injected natural gas, together with various ways of achieving hypergolic combustion were compared on the basis of their projected chances of leading to diesel-like combustion. The hypergolic combustion schemes ranked highest, and several were subsequently investigated on a theoretical and experimental basis. One of these schemes was based on electrical activation of the gas prior to injection and showed diesel-like performance in a direct-injected reciprocating engine. The second scheme is based on activation via partial catalytic combustion and is believed to be capable of comparable performance. Studies of the gas pressurization system show that the total system efficiency will be highest is compression to the required injection pressure is carried out at constant temperature, but for the near term, a two or three stage intercooled system will probably be employed. GRA

N87-15938# Joint Publications Research Service, Arlington, Va.
APPLICATIONS OF INDUSTRIAL ROBOTS TO MACHINING DISCUSSED
Kanji Yoneyama *In its* Japan report: Science and Technology (JPRS-JST-87-001) 7 Jan. 1987 p 91-97 Transl. into ENGLISH from Kikai to Kogu (Tokyo, Japan), May 1986 p 17-25 (For primary document see N87-15934 08-01)
Avail: NTIS HC A06/MF A01

N87-16324*# NASTEC, Inc., Cleveland, Ohio.
DESIGN AND TESTING OF AN ELECTROMAGNETIC COUPLING
William J. Anderson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 31-43 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13K

N87-16326*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DESIGN AND ANALYSIS OF A KEEL LATCH FOR USE ON THE HUBBLE SPACE TELESCOPE
John Calvert and Melanie Stinson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 55-71 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16327*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MIRROR TRANSPORT MECHANISM FOR USE AT CRYOGENIC TEMPERATURES
Kenneth W. Stark and Meredith Wilson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 73-95 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16330*# Battelle Columbus Labs., Ohio.
ROLLING ELEMENT BEARINGS IN SPACE
J. W. Kannel and K. F. Dufrane *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 121-132 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16333*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DUAL WOUND dc BRUSH MOTOR GEARHEAD
Barrie W. Henson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 165-178 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A HIGH-TORQUE BACKLASH-FREE ROLLER ACTUATOR
Bruce M. Steinetz, Douglas A. Rohn, and William Anderson (NASTEC, Inc., Cleveland, Ohio) *In its* The 20th Aerospace Mechanics Symposium May 1986 p 205-230 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16337*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PRECISION, THERMALLY-ACTIVATED DRIVER FOR SPACE APPLICATION
Robert C. Murray (PRC Kentron, Inc., Hampton, Va.), Robert F. Walsh, and William H. Kinard *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 231-239 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16338*# Sperry Corp., Phoenix, Ariz. Space Systems Div.
SPACE STATION ROTARY JOINT MECHANISMS
Glen W. Driskill *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 241-251 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16339*# Boeing Aerospace Co., Seattle, Wash.
HYDRAULIC MECHANISM TO LIMIT TORSIONAL LOADS BETWEEN THE IUS AND SPACE TRANSPORTATION SYSTEM ORBITER
James R. Farmer *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 253-263 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16340*# S and Q Corp., Morgan Hill, Calif.
DESIGN AND DEVELOPMENT OF A LARGE DIAMETER HIGH PRESSURE FAST ACTING PROPULSION VALVE AND VALVE ACTUATOR
K. V. Srinivasan *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 265-276 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16342*# Akron Univ., Ohio.
A MECHANISM FOR PRECISE LINEAR AND ANGULAR ADJUSTMENT UTILIZING FLEXURES
J. R. Ellis *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 291-302 (For primary document see N87-16321 08-39)
(Grant NAG3-379; Contract N7405-ENG-26)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16343*# Itek Corp., Newton, Mass. Measurement Systems Div.
WEIGHT AND POWER SAVINGS SHAFT ENCODER INTERFACING TECHNIQUES FOR AEROSPACE APPLICATIONS
Donald H. Breslow *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 303-311 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

N87-16346# Ohio State Univ., Columbus. Dept. of Civil Engineering.
EARTH PENETRATION BY SOLID IMPACTORS
H. Adeli, A. M. Amin, and R. L. Sierakowski *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 9 Sep. 1986 p 15-22 (For primary document see N87-16344 08-39)
Avail: NTIS HC A05/MF A01

N87-16767*# Auburn Univ., Ala. Dept. of Materials Engineering.
WELD RADIOGRAPH ENIGMAS
Wartan A. Jemian *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

N87-16771*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
ANALYTICAL FORMULATION OF ORBITER-PAYLOAD COUPLED BY TRUNNION JOINTS WITH COULOMB FRICTION
Frank C. Liu *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 35 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

N87-16780*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
A STUDY OF BOILING HEAT TRANSFER AS APPLIED TO THE COOLING OF BALL BEARINGS IN THE HIGH PRESSURE OXYGEN TURBOPUMP OF THE SPACE SHUTTLE MAIN ENGINE
Will Schreiber *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N87-16302# California Univ., Davis. Intercollege Div. of Statistics.
ESTIMATING IFRA (INCREASING FAILURE RATE AVERAGE) BASED ON CENSORED DATA
Jane-Ling Wang Nov. 1985 21 p
(Grant AF-AFOSR-0268-85)
(AD-A172004; TR-70; AFOSR-86-0655TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper considers the problem of estimating a survival curve from randomly right censored data when it is known to have increasing Failure Rate Average (IFRA), or to be New Better than Used (NBU). Let F sub n(t) be the product-limit estimator (PL-estimator) of Kaplan and Meier for the life distribution. Since F sub n(t) never has the IFRA property and may not be NBU, we

modify F sub n(t) to have the desired IFRA (NBU) properties. The modified estimators are easy to compute and, under mild conditions, are shown to be asymptotically n raised to the 1/2 power-equivalent to F sub n(t) on compact intervals. Thus the modified estimators share the asymptotic properties of the PL-estimator F sub n(t).
Author (GRA)

N87-16303# Stanford Univ., Calif. Lab. of Physics.
APPLICATION OF NONDESTRUCTIVE TESTING TECHNIQUES TO MATERIALS TESTING Annual Report, 1 Jan. - 31 Dec. 1985
G. S. Kino Feb. 1986 78 p
(Grant AF-AFOSR-0063-84)
(AD-A172005; AFOSR-86-0635TR) Avail: NTIS HC A05/MF A01 CSCL 14/2

A range of fundamentally new optical nondestructive techniques has been demonstrated for measurements of surface defects, range, surface profiles and acoustic and thermal displacements of a surface. A wide aperture acoustic beam has been demonstrated to measure range to a far greater accuracy than with conventional NDT systems using short pulses. The range resolution of such a lens is comparable to a wavelength while that for a short pulse system is, at best, two or three wavelengths. Optical methods, developed during the program, have been successful in measuring film thicknesses to an accuracy of an order if 200A. GRA

N87-16304# Illinois Univ., Chicago. Statistical Lab.
CLOSURE OF THE NBUE (NEW BETTER THAN USED IN EXPECTATION) AND DMRL (DECREASING MEAN RESIDUAL LIFE) CLASSES UNDER FORMATION OF PARALLEL SYSTEMS
A. Abouammoh and E. El-Neweihi Dec. 1985 9 p Prepared in cooperation with King Saud Univ., Riya
(Grant AF-AFOSR-0320-85)
(AD-A172094; AFOSR-86-0710TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The class of new better than used in expectation (NBUE) life distributions arises quite naturally in considering maintenance and replacement policies. The class of life distributions with decreasing mean residual life (DMRL) is receiving a good deal of current attention, especially in biostatistics. It is well known that the NBUE class and the DMRL class are not closed under the formation of general coherent systems with independent components. In fact a series system with independent and identically distributed (i.i.d.) NBUE components may not have an NBUE life distribution. However, the question as to whether or not the NBUE and the DMRL properties are preserved under the formation of parallel system with i.i.d. units has remained open. In this note we show that the class of NBUE life distributions and the class of differentiable DMRL life distributions are both closed under the formation of parallel systems with i.i.d. units. GRA

N87-16305# Grumman Aerospace Corp., Bethpage, N.Y.
ENVIRONMENTAL STRESS SCREENING TECHNOLOGY Final Report, Sep. 1983 - Mar. 1985
Herbert Quartin, Frank Kube, Joseph Popolo, John Connelly, and Frederick Danner Oct. 1985 109 p
(Contract F33615-83-C-3406)
(AD-A172737; RSM-85-R-03; AFWAL-TR-85-3073) Avail: NTIS HC A06/MF A01 CSCL 09/5

The objective of this study was to evaluate the feasibility of using infrared thermography for the detection and growth tracking of environmentally sensitive workmanship defects in printed circuit board assemblies. It was determined that the detection of defects, as manifested by power deviations as small as 15 milliwatts, is practical and feasible under static environmental conditions. Techniques for the use of infrared thermography under dynamic environmental conditions were also developed and evaluated. These techniques allowed the detection of intermittent as well as permanent failures. In all cases, the environmental stimulus was random vibration and rapid thermal cycling. The ability of infrared thermography to detect the growth of a defect was verified and determined to equate to power changes on the order of 5 milliwatts. The experimental results were sufficiently accurate and repeatable to warrant continued investigations into the development of a failure prediction method. GRA

N87-16306# Sandia National Labs., Albuquerque, N. Mex. Nondestructive Testing Technology Div.
NONDESTRUCTIVE TESTING AT SANDIA NATIONAL LABORATORIES, ALBUQUERQUE
K. R. Thompson, ed. and R. D. Costley, ed. Apr. 1986 19 p
(Contract DE-AC04-76DP-00789)
(DE86-014792; SAND-86-0046) Avail: NTIS HC A02/MF A01

The NDT divisions, Nondestructive Testing (7551) and Nondestructive Testing Technology (7552), analyze material properties, locate and characterize flaws within materials, monitor the internal operation of complex mechanisms, and determine the integrity of bonds between materials. The techniques listed in Contents are applied. This manual describes each technique and facility and directs potential users to the appropriate personnel for further information. DOE

N87-16307# United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
THE MODELLING OF ELECTRICAL CURRENT NDT METHODS AND ITS APPLICATION TO WELD TESTING
R. Becker, K. Betzold, K. D. Boness, R. Collins, C. C. Holt, and J. Simkin Mar. 1986 52 p
(AERE-R-12114; V-792-85) Avail: NTIS HC A04/MF A01

Eddy current testing (ET), potential drop (PD) and current perturbation (CP) methods of non-destructive testing (NDT) are discussed. A background is provided for the practitioners of NDT who inspect welds. No attempt is made to present the mathematics of modelling. Rather, the aim is to describe the nature, scope and importance of modelling. The majority of the examples of ET and CP modelling that are provided are not directly concerned with welds. However, it is helpful to review examples with simple configurations before the significance of modelling for weld inspection is described. Thus, modelling is firstly introduced without particular regard to welds and is then discussed in relation to the improvement of weld inspection. Definitions are provided for the technical expressions which the authors have found it convenient to use. Author

N87-16308# United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
COMPUTERS IN ULTRASONIC NDT
B. J. Smith and R. Martin May 1986 37 p
(AERE-R-12110) Avail: NTIS HC A03/MF A01

The paper reviews the various aspects of the development of ultrasonic non-destructive testing (NDT) techniques made possible by the use of computers. Computerized control of scanning rigs, data collection, analysis and display are described. The advantages of whole waveform collection and analysis are discussed, as are some of the associated problems and their solutions. It is concluded that the use of computers has added flexibility in the use of equipment. It has permitted optimization of the scanning of specimens, offered greater data storage possibilities and given greater scope in the analysis and display of data.
Author

N87-16776*# Tennessee Technological Univ., Cookeville. Dept. of Matehmatics and Computer Science.
STATISTICAL ANALYSIS OF FAILURE DATA ON CONTROLLERS AND SSME TURBINE BLADE FAILURES
S. A. Patil *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 27 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N87-16309 Pittsburgh Univ., Pa.
THE LARGE DEFLECTION OF A COMPOUND VISCOELASTIC CANTILEVER BEAM Ph.D. Thesis
Richard B. Chianese 1985 215 p
Avail: Univ. Microfilms Order No. DA8617203

Recent developments in engineering materials have led to the expanded use of plastics and polymers in engineering structures. These materials permit the engineering designer to improve the weight, cost and efficiency of structural designs. Often, these materials are combined to form compound beams which take efficient advantage of the properties of each material. Plastics and polymers are viscoelastic materials, which exhibit creep, that is, a deformation under constant load which increases with time. This is especially true at the elevated operating temperatures of many engineering designs. A successful structural design must account for the time varying deflection. The large, non-linear, deflection of compound viscoelastic beams is most often encountered in the case of laterally loaded cantilevers. An analytical procedure is presented which will compute the time varying large deflection of compound viscoelastic cantilevers. The procedure divides the deflected beam into a series of circular arc segments tangent to one another at the points of intersection. An iterative integration scheme is used to calculate the deflected shape of the beam at any time. The analytical method is capable of treating the general case of a compound viscoelastic beam in which the centroids of the various material areas are not concentric. The location of the neutral axis is a function of time in such cases.
Dissert. Abstr.

N87-16310 Ohio State Univ., Columbus.
ANALYSIS OF ELASTIC-PLASTIC CONTINUUM AT LARGE DEFORMATION USING HYBRID DESCRIPTIONS AND FINITE ELEMENT METHOD Ph.D. Thesis
Sherif Fathy Ayoub 1986 177 p
Avail: Univ. Microfilms Order No. DA8618736

The nonlinear nature of the stress-strain relations in large deformation plasticity is examined. An accurate and convenient formulation that uses the total Lagrangian description for history of configurations and the Eulerian description for constitutive equations is presented. The formulation of the incremental equation of motions is based on the principle of virtual work. Constitutive relations for von Mises materials are derived based on the assumptions of the existence of a convex yield surface, the normality condition and the decomposition of the strain rate into the sum of an elastic and a plastic strain rate. A nonlinear finite element computer code with an automatic incrementation is developed for the numerical analysis of axisymmetric and plane-strain continua. The best suited for the case of unsymmetrical stiffnesses, is adopted. Applications to the prediction of ultimate load for a half space subjected to a rigid punch and the upsetting of a cylinder up to 40% reduction in height are illustrated. The ultimate load obtained is in excellent agreement with the theoretical value. The deformed shape of the upset cylinder is more regular than other analyses. Isoparametric quadrilateral four-noded elements along with some modifications were used. The best performance was by the modified element QM4 in which the sheering stress is assumed to be constant over each element.

N87-16311 ESDU International Ltd., London (England).
ELASTIC BUCKLING OF UNBALANCED LAMINATED FIBRE REINFORCED COMPOSITE PLATES (RECTANGULAR PLATES OF AsBtDs TYPE, ALL EDGES SIMPLY-SUPPORTED UNDER BIAXIAL LOADING)
Dec. 1986 46 p
(ESDU-86020; ISBN-0-85679-572-0; ISSN-0141-4097) Avail: ESDU

This Data Item ESDU 86020 is an addition to the Structures and Composites Sub-series. A FORTRAN computer program is given for calculating the buckling loading of a particular class of unbalanced composite plates; in both the direct and flexural stiffness matrices the first two terms in the last column and first row are zero and in the coupling stiffness matrix the first two terms of the first two rows and the last term of the third row are zero. Such stiffness matrices arise when the fibers are all laid to make the same angle with a plate edge, but the angles are of opposite signs in each pair of laminae equidistant from the center plane. The plate is assumed to be initially flat and rectangular, with loading applied uniformly along the edges. No account is taken of through-the-thickness shear deformation. Uniaxial or biaxial loading (in which one load can be tensile) is treated; under biaxial loading either the transverse loading may be fixed, and the longitudinal loading at buckling determined, or the ratio of transverse to longitudinal loading may be fixed, and the loads in that ratio at buckling found. Example curves illustrate the variation of the buckling load with plate aspect ratio showing the influence of the coupling stiffness matrix. The listing of the program (and the equations on which it is based) are included, and magnetic media are available as ESDUpac 1057. ESDU

N87-16312 ESDU International Ltd., London (England).
ESTIMATION OF RMS STRAIN IN LAMINATED FACE PLATES OF SIMPLY SUPPORTED SANDWICH PANELS SUBJECTED TO RANDOM ACOUSTIC LOADING: INCLUDING A SIMPLIFIED NATURAL FREQUENCY PREDICTION METHOD
Oct. 1986 53 p
(ESDU-86024; ISBN-0-85679-576-3; ISSN-0141-3961) Avail: ESDU

This Data Item ESDU 86024 is an addition to the Acoustic Fatigue Sub-series. A computer program is given in both BASIC and FORTRAN, for the rms surface strains in two orthogonal directions at the center of the face plates. In estimating strains it is assumed the panel responds only in its fundamental mode and that the loading spectral density is constant over a range of frequencies that includes the predominant response frequency. The method applies to sandwich panel with thin, flat, or slightly curves, face plates having principal axes or orthotropy parallel to the panel edges; the face plates may be of dissimilar materials and thicknesses, and the core is assumed to have zero flexural stiffness. The panel is assumed to have simply-supported edges but, since that cannot be achieved in practice, the use of effective panel dimensions allows real edge conditions to be approximated and guidance is included on the choice of values. A comparison is shown of experimental results, for center strains extracted from the literature for honeycomb core sandwich panels with fiber-reinforced laminated face plates, and rms strains predicted using the program. ESDU

N87-16313 ESDU International Ltd., London (England).
FATIGUE STRENGTH OF KEYED ASSEMBLIES
Dec. 1986 20 p
(ESDU-86028; ISBN-0-85679-580-1; ISSN-0141-4089) Avail: ESDU

ESDU 86028 discusses the effect of keyway design on the stress distribution, stress concentration and, hence, on fatigue strength. The effect of fit is considered and types of failure by crack propagation illustrated. Data are presented on the fatigue strength of shaft with keyway in bending, and a shaft loaded through the key in torsion. Stress concentration values as a function of keyway geometry are also presented for a shaft with keyway in bending, and a shaft loaded through the key in torsion. A worked example illustrates the use of the data. ESDU

N87-16314 ESDU International Ltd., London (England).
CIRCULAR-CYLINDRICAL STRUCTURES: LATERAL DYNAMIC RESPONSE TO ATMOSPHERIC TURBULENCE
Dec. 1986 37 p
(ESDU-86036; ISBN-0-85679-588-7; ISSN-0143-2702) Avail: ESDU

This Data Item ESDU 86036 is an addition to the Wind Engineering Sub-series. A simplified procedure, together with charts, is given for estimating the across-wind deflection due to lateral buffeting of circular-cylindrical structures (such as stack, process columns, or individual members fixed at both ends). The method may be applied to tapered or stepped cylinders, or cylinders with aerodynamic spoilers fitted. It is derived from a theoretical analysis also detailed that uses the latest turbulence models from ESDU 85020 and 86010, but simplified where possible for application to typical structures. Input to the method is only the mass and dimensions together with natural frequency, mode shape, and characteristic values of mean wind speed and turbulence, for all of which guidance is given. A computer program and comprehensive worked example are included. The overall lateral response for a range of wind speeds is obtained by combining that due to vortex sheeding (predicted using ESDU 85038 or 85039) with that predicted here. To obtain the maximum response at any wind speed, that lateral response must be combined with the along-wind response. Guidance is provided on how the responses may be combined to obtain a conservative estimate of maximum overall response. ESDU

N87-16315# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 5 Monthly Report
Judith Nagle-Eshleman, ed. May 1986 95 p
(AD-A168869) Avail: NTIS HC A05/MF A01 CSCL 13/13

Topics addressed include: mechanical systems; structural systems; vehicle systems; biological sytems; mechanical components; structural components; dynamic environment; experimentation; analysis and design; and mechanical properties. For individual titles, see N87-16316 through N87-16317.

N87-16316# Gupta Engineers, Fremont, Calif.
FINITE ELEMENT ANALYSIS OF VIBRATION OF TAPERED BEAMS
A. K. Gupta *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 5 May 1986 p 3-6 (For primary document see N87-16315 08-39)
Avail: NTIS HC A05/MF A01 CSCL 13/13

Various approaches for finite element analysis of vibration of tapered beams and frames composed of tapered beams are discussed. Applicability, accuracy, and computational efficiency of the stiffness and consistent mass matrices for tapered beam elements, derived by various authors are reviewed. Author

N87-16317# Aberdeen Univ. (Scotland). Dept. of Engineering.
THEORETICAL STUDIES ON FLEXURAL WAVE PROPAGATION IN BEAMS: A COMPREHENSIVE REVIEW. PART 2: TRANSIENT RESPONSE OF TIMOSHENKO BEAMS
M. M. Al-Mousawi *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 5 May 1986 p 9-21 (For primary document see N87-16315 08-39)
Avail: NTIS HC A05/MF A01 CSCL 13/13

A comprehensive review related to the problems of flexural wave propagation in beams is presented: historical background; use of Timoshenko beam theory, including the effects of shear distortion and rotary inertia, for vibrational and transient analysis of beams; and elastic stress wave propagation in beams with discontinuities of cross section. Author

N87-16318# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 4 Monthly Report
Judith Nagle-Eshleman, ed. Apr. 1986 82 p
(AD-A167865) Avail: NTIS HC A05/MF A01 CSCL 13/13

A primer is given on random vibration techniques in structural engineering. The historical backgroung of flexural wave propagation in beams is given. Abstracts from the current literature are presented. For individual titles, see N87-16319 through N87-16320.

N87-16319# Rice Univ., Houston, Tex. Dept. of Civil Engineering.
A PRIMER OF RANDOM VIBRATION TECHNIQUES IN STRUCTURAL ENGINEERING
P. D. Spanos and L. D. Lutes *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 4 Apr. 1986 p 3-9 (For primary document see N87-16318 08-39)
Avail: NTIS HC A05/MF A01 CSCL 13/13

A review of random vibration techniques for analyzing dynamic systems is presented from the perspective of applicability to structural engineering. Problems involving linear or nonlinear, elastic or inelastic structural models are discussed. Author

N87-16320# Aberdeen Univ. (Scotland). Dept. of Engineering.
THEORETICAL STUDIES ON FLEXURAL WAVE PROPAGATION IN BEAMS: A COMPREHENSIVE. PART 1: HISTORICAL BACKGROUND
M. M. Al-Mousawi *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 4 Apr. 1986 p 11-17 (For primary document see N87-16318 08-39)
Avail: NTIS HC A05/MF A01 CSCl 13/13

A comprehensive review is given of flexural wave propagation in beams. Here, the historical background is given. Author

N87-16321*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE 20TH AEROSPACE MECHANICS SYMPOSIUM
May 1986 316 p Symposium held in Cleveland, Ohio, 7-9 May 1986; sponsored by NASA, the California Inst. of Tech. and LMSC
(NASA-CP-2423-Rev; E-2904; NAS 1.55:2423-Rev) Avail: NTIS HC A14/MF A01 CSCL 20K

Numerous topics related to aerospace mechanisms were discussed. Deployable structures, electromagnetic devices, tribology, hydraulic actuators, positioning mechanisms, electric motors, communication satellite instruments, redundancy, lubricants, bearings, space stations, rotating joints, and teleoperators are among the topics covered. For individual titles, see N87-16322 through N87-16343.

N87-16322*# Messerschmitt-Boelkow-Blohm/Entwicklungsring Nord, Bremen (West Germany).
DESIGN AND DEVELOPMENT OF A TELESCOPIC AXIAL BOOM c18
Roland Felkai *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 1-12 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 22B

A special telescopic boom has been design-optimized, developed and qualified to carry an S-band antenna for the German Telecommunication Satellite is discussed. The design driver requirements, the alternatives investigated, the final technical solution, the tests performed, and special problem areas encountered during its development are discussed. Author

N87-16323*# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
EXTENDABLE RETRACTABLE TELESCOPIC MAST FOR DEPLOYABLE STRUCTURES c18
M. Schmid and M. Aguirre (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 13-29 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 22B

The Extendable and Retractable Mast (ERM) which is presently developed by Dornier in the frame of an ESA-contract, will be used to deploy and retract large foldable structures. The design is based on a telescopic carbon-fiber structure with high stiffness, strength and pointing accuracy. To verify the chosen design, a breadboard model of an ERM was built and tested under thermal vacuum (TV)-conditions. It is planned as a follow-on development to manufacture and test an Engineering Model

Mast. The Engineering Model will be used to establish the basis for an ERM-family covering a wide range of requirements. Author

N87-16324*# NASTEC, Inc., Cleveland, Ohio.
DESIGN AND TESTING OF AN ELECTROMAGNETIC COUPLING c37
William J. Anderson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 31-43 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13K

Hostile environments such as the hard vacuum of space, and exposure to water or caustic fluids have fostered the development of devices which allow mechanical rotary feed throughs with positive sealing without the use of conventional dynamic seals. One such device is an electromagnetic coupling which transfers motion across a hermetic seal by means of a rotating magnetic field. Static pull-out torque and dynamic heat build-up and pull-out torque tests of a synchronous reluctance homopolar coupling are reported herein. Coupling efficiencies are estimated for a range of speeds and torques. Author

N87-16325*# Ball Bros. Research Corp., Boulder, Colo.
SLIP RING EXPERIENCE IN LONG DURATION SPACE APPLICATIONS c33
Damon D. Phinney *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 45-54 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

Ball Aerospace experience with slip rings in space extends back to 1962. Over 40 multi-ring assemblies have been flown and continuous operating lifetimes greater than 8 years at up to 60 rpm have been demonstrated. Slip rings provide multi-channel transfer of electrical power and signals in assemblies that are small in size and weight, and low in cost. By use of multiple brushes and sufficient copper within the assembly, power transfer efficiency better than 99.95 percent for high voltage circuits can be achieved. A low slip ring failure rate based on actual space operation totalling billions of ring revolutions has been established. Well qualified suppliers who have been making slip rings for space use for over 25 years are available. It is hoped that the suspected problem in SEASAT will not be allowed to prejudice space system designer against these very useful mechanisms. Author

N87-16326*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DESIGN AND ANALYSIS OF A KEEL LATCH FOR USE ON THE HUBBLE SPACE TELESCOPE c37
John Calvert and Melanie Stinson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 55-71 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The mechanical design of the keel latch is discussed, as well as the stress analysis of the keel latch. Background information; mechanical design requirements; some of the initial design considerations; the design considerations that led to the selection of the final design; the mechanics of the final design; testing that has been and will be accomplished to verify that design requirements have been met; and future tests are discussed. Author

N87-16327*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MIRROR TRANSPORT MECHANISM FOR USE AT CRYOGENIC TEMPERATURES c37
Kenneth W. Stark and Meredith Wilson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 73-95 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The Mirror Transport Mechanism (MTM), which supports a pair of dihedral mirrors and moves them in a very smooth and uniform scanning motion normal to a beamsplitter is described. Each scan is followed by a quick flyback and repeat. Material selection, design, and testing of all major components of the MTM are discussed. Flex pivot failures during vibration testing, excessive dihedral platform sag under one g operation, electronic and fiber optic characteristics, and tolerancing considerations are covered. Development of the mechanism has reached the final phase of thermal and vibration qualification. Environmental testing of the complete FIRAS experiment is just beginning. Author

N87-16328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHUTTER MECHANISM FOR CALIBRATION OF THE CRYOGENIC DIFFUSED INFRARED BACKGROUND EXPERIMENT (DIRBE) INSTRUMENT c35
Allen Tyler *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 97-102 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 14B

The design requirements, the design, the assembly and alignment, and the test program for a shutter mechanism which must operate at cryogenic temperature and draw less than 1.0 milliwatt are discussed. The design solution to meet these requirements is a device that positions a mirror with repeated accuracy, has no wearing surfaces, and operates at 2.0 K. The unique feature of this device is the simplicity of the mechanism, thus obtaining high reliability. Author

N87-16329*# United Kingdom Atomic Energy Authority, Risley (England). Space Tribology Lab.
TOWARDS AN OPTIMISED SPUTTERED MoS2 LUBRICANT FILM c27
E. W. Roberts *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 103-119 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 11G

It is shown that the tribological quality of MoS2 lubricant films formed by magnetron sputtering is determined by the choice of sputtering conditions. By selecting the appropriate conditions, films of extremely high lubricity and endurance (in vacuum), which are well suited to many space applications, are obtained. Such MoS2 films, when applied to precision ball hearings, give rise to the lowest torques (for the given test conditions) yet seen in our laboratory. While a remarkably good performance is obtained in vacuum, tests in air show a marked deterioration in lubricating qualities. It is demonstrated that this is attributable to the adsorption of water vapor on MoS2 surfaces and that the degree of deterioration is related to the partial pressure of water vapor present. Analysis of results indicates that the factors relevant to obtaining optimum films are deposition rate and film composition. Author

N87-16330*# Battelle Columbus Labs., Ohio.
ROLLING ELEMENT BEARINGS IN SPACE c37
J. W. Kannel and K. F. Dufrane *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 121-132 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

Some of the advances in tribology that have been associated with aerospace mechanisms are discussed. The needs of aerospace have been the dominant forces leading to improvements in understanding and applying tribology technology. In the past two decades improvements in understanding bearing torque, elastohydrodynamic lubrication, lubricant distribution, cage stability, and transfer film lubricants have been made. It is anticipated that further developments will be made in response to future aerospace requirements. Author

N87-16331*# California Univ., Santa Barbara.
DUTY CYCLE TESTING AND PERFORMANCE EVALUATION OF THE SM-229 TELEOPERATOR c54
Robert S. Stoughton and Daniel P. Kuban (Oak Ridge National Lab., Tenn.) *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 133-148 Previously announced as N86-31059 (For primary document see N87-16321 08-39)
(Contract DE-AC05-84OR-21400)

Avail: NTIS HC A14/MF A01 CSCL 05H

The first known experimental studies and analyses of teleoperator performance for specific duty cycles are discussed. The results are presented in two distinct areas as position usage patterns, and as three-dimensional power grids. The position usage patterns are a valuable means to assess the available motion range. The power grids are a unique concept for evaluating joint performance. Final conclusions contain recommendations to upgrade the teleoperator for optimum performance. Author

N87-16332*# Mechanical Dynamics, Inc., Ann Arbor, Mich.
PSEUDO-PROTOTYPING OF AEROSPACE MECHANICAL DYNAMIC SYSTEMS WITH A GENERALIZED COMPUTER PROGRAM **c61**
Vikram N. Sohoni and Milton A. Chace *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 149-163 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09B

The ADAMS computer program for automated analysis of mechanisms and machines is described. The program automatically formulates mathematical models for prototype or existing mechanisms with the minimum necessary physical and geometric data. The model can then be analyzed in various modes of analysis. The outputs (displacements, velocities, acceleration and forces) can be produced in tabular and graphical (plots, wire frame graphics) form. The application of this computer program to simulating satellite docking maneuvers is illustrated. Author

N87-16333*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DUAL WOUND dc BRUSH MOTOR GEARHEAD **c37**
Barrie W. Henson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 165-178 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The design requirements, the design, development tests and problems, the qualification and life test and the findings of the strip examination of a dual wound DC brushed motor gearhead are described. It is the only space qualified dual wound dc brushed motor gearhead in Europe. Author

N87-16334*# Moore Reed and Co. Ltd., Andover (England).
REDUNDANCY FOR ELECTRIC MOTORS IN SPACECRAFT APPLICATIONS **c33**
Robert J. Smith and Alastair R. Flew *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 179-194 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

The parts of electric motors which should be duplicated in order to provide maximum reliability in spacecraft application are identified. Various common types of redundancy are described. The advantages and disadvantages of each are noted. The principal types are illustrated by reference to specific examples. For each example, constructional details, basic performance data and failure modes are described, together with a discussion of the suitability of particular redundancy techniques to motor types. Author

N87-16335*# Hughes Space and Communications Group, El Segundo, Calif.
RF SWITCH POSITIONER FOR COMMUNICATIONS SATELLITE NETWORK **c33**
A. G. Storaasli, H. P. Griesser, and R. W. Grant *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 195-203 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09A

The RF switch positioner is a simple, lightweight, redundant positioning mechanism used to reconfigure the antenna beam on the INTELSAT VI satellite. It simultaneously rotates approximately 100 squareax waveguide switches through a full 360 deg. The RF switch positioner has been space qualified and has performed to expectations in conjunction with the feed networks in range testing. Author

N87-16336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A HIGH-TORQUE BACKLASH-FREE ROLLER ACTUATOR **c37**
Bruce M. Steinetz, Douglas A. Rohn, and William Anderson (NASTEC, Inc., Cleveland, Ohio) *In its* The 20th Aerospace Mechanics Symposium May 1986 p 205-230 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The results are presented of a test program that evaluated the stiffness, accuracy, torque ripple, frictional losses, and torque holding capability of a 16:1 ratio, 430 N-m (320 ft-lb) planetary roller drive for a potential space vehicle actuator application. The drive's planet roller supporting structure and bearings were found to be the largest contributors to overall drive compliance, accounting for more than half of the total. In comparison, the traction roller contacts themselves contributed only 9 percent of the drive's compliance based on an experimentally verified stiffness model. The drive exhibited no backlash although 8 arc sec of hysteresis deflection were recorded due to microcreep within the contact under torque load. Because of these load-dependent displacements, some form of feedback control would be required for arc second positioning applications. Torque ripple tests showed the drive to be extremely smooth, actually providing some damping of input torsional oscillations. The drive also demonstrated the ability to hold static torque with drifts of 7 arc sec or less over a 24 hr period at 35 percent of full load. Author

N87-16337*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PRECISION, THERMALLY-ACTIVATED DRIVER FOR SPACE APPLICATION **c37**
Robert C. Murray (PRC Kentron, Inc., Hampton, Va.), Robert F. Walsh, and William H. Kinard *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 231-239 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

A space qualified, precision, large force, thermally-activated driver that has been developed jointly by the NASA Langley Research Center and PRC Kentron is described. The driver consists of a sealed hydraulic cylinder containing a metal bellows, a bellows plug, a coil spring, a spring retainer, and output shaft, a shaft guide, and a quantity of silicone oil. Temperature changes cause the silicone oil to expand or contract thus contracting or expanding the bellows/spring assembly thereby extending or retracting the output shaft. Author

N87-16338*# Sperry Corp., Phoenix, Ariz. Space Systems Div.
SPACE STATION ROTARY JOINT MECHANISMS **c37**
Glen W. Driskill *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 241-251 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The mechanism which will be used on the space station to position the solar arrays and radiator panels for Sun pointing and Sun avoidance is described. The unique design features will be demonstrated on advanced development models of two of the joints being fabricated under contract to NASA-MSFC. Author

N87-16339*# Boeing Aerospace Co., Seattle, Wash.
HYDRAULIC MECHANISM TO LIMIT TORSIONAL LOADS BETWEEN THE IUS AND SPACE TRANSPORTATION SYSTEM ORBITER **c37**
James R. Farmer *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 253-263 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The Inertial Upper Stage (IUS) is a two-stage booster used by NASA and the Defense Department to insert payloads into geosynchronous orbit from low-Earth orbit. The hydraulic mecha-

nism discussed here was designed to perform a specific dynamic and static interface function within the Space Transportation System's Orbiter. Requirements, configuration, and application of the hydraulic mechanism with emphasis on performance and methods of achieving zero external hydraulic leakage are discussed. The hydraulic load-leveler mechanism meets the established design requirements for operation in a low-Earth orbit. Considerable testing was conducted to demonstrate system performance and verification that external leakage had been reduced to zero. Following each flight use of an ASE, all hydraulic mechanism components are carefully inspected for leakage. The ASE, including the hydraulic mechanism, has performed without any anomalies during all IUS flights. Author

N87-16340*# S and Q Corp., Morgan Hill, Calif.
DESIGN AND DEVELOPMENT OF A LARGE DIAMETER HIGH PRESSURE FAST ACTING PROPULSION VALVE AND VALVE ACTUATOR c37
K. V. Srinivasan *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 265-276 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

The design and development of a large diameter high pressure quick acting propulsion valve and valve actuator is described. The valve is the heart of a major test facility dedicated to conducting full scale performance tests of aircraft landing systems. The valve opens in less than 300 milliseconds releasing a 46-centimeter- (18-in.-) diameter water jet and closes in 300 milliseconds. The four main components of the valve, i.e., valve body, safety shutter, high speed shutter, and pneumatic-hydraulic actuator, are discussed. This valve is unique and may have other aerospace and industrial applications. Author

N87-16341*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DISCRETE MECHANISM DAMPING EFFECTS IN THE SOLAR ARRAY FLIGHT EXPERIMENT
E. D. Pinson *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 277-289 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 20K

Accelerometer data were collected during on-orbit structural dynamic testing of the Solar Array Flight Experiment aboard the Space Shuttle, and were analyzed at Lockheed Missile and Space Co. to determine the amount of damping present in the structure. The results of this analysis indicated that the damping present in the fundamental in-plane mode of the structure substantially exceeded that of the fundamental out-of-plane mode. In an effort to determine the source of the higher in-plane damping, a test was performed involving a small device known as a constant-force spring motor or constant-torque mechanism. Results from this test indicate that this discrete device is at least partially responsible for the increased in-plane modal damping of the Solar Array Flight Experiment structure. Author

N87-16342*# Akron Univ., Ohio.
A MECHANISM FOR PRECISE LINEAR AND ANGULAR ADJUSTMENT UTILIZING FLEXURES c37
J. R. Ellis *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 291-302 (For primary document see N87-16321 08-39)
(Grant NAG3-379; Contract N7405-ENG-26)
Avail: NTIS HC A14/MF A01 CSCL 13I

The design and development of a mechanism for precise linear and angular adjustment is described. This work was in support of the development of a mechanical extensometer for biaxial strain measurement. A compact mechanism was required which would allow angular adjustments about perpendicular axes with better than 0.001 degree resolution. The approach adopted was first to develop a means of precise linear adjustment. To this end, a mechanism based on the toggle principle was built with inexpensive and easily manufactured parts. A detailed evaluation showed that the resolution of the mechanism was better than 1 micron and that adjustments made by using the device were repeatable. In the second stage of this work, the linear adjustment mechanisms were used in conjunction with a simple arrangement of flexural pivots and attachment blocks to provide the required angular adjustments. Attempts to use the mechanism in conjunction with the biaxial extensometer under development proved unsuccessful. Any form of in situ adjustment was found to cause erratic changes in instrument output. These changes were due to problems with the suspension system. However, the subject mechanism performed well in its own right and appeared to have potential for use in other applications. Author

N87-16343*# Itek Corp., Newton, Mass. Measurement Systems Div.
WEIGHT AND POWER SAVINGS SHAFT ENCODER INTERFACING TECHNIQUES FOR AEROSPACE APPLICATIONS c37
Donald H. Breslow *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 303-311 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 13I

Many aerospace applications for shaft angle digitizers such as optical shaft encoders require special features that are not usually required on commercial products. Among the most important user considerations are the lowest possible weight and power consumption. A variety of mechanical and electrical interface techniques that have large potential weight and power savings are described. The principles to be presented apply to a wide variety of encoders, ranging from 16 to 22 bit resolution and with diameters from 152 to 380 mm (6 to 15 in.). Author

N87-16344# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 9 Monthly Report
Judith Nagle-Eshleman, ed. Sep. 1986 90 p
(AD-A173095) Avail: NTIS HC A05/MF A01

Topics addressed include: random testing for distribution qualification; solid impactors; boundary element techniques; earthquake source modeling; review of meetings; mechanical and structural systems; vehicle systems; structural and mechanical components; dynamic environment; experimentation; and design analysis. For individual titles, see N87-16345 through N87-16346.

N87-16345# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
RANDOM TESTING WITH DIGITAL CONTROL: APPLICATION IN THE DISTRIBUTION QUALIFICATION OF MICROCOMPUTERS
C. W. deSilva, S. J. Henning (International Business Machines Corp., Boca Raton, Fla.), and J. D. Brown *In* Shock and Vibration Information Center. The Shock and Vibration Digest, Volume 18, No. 9 Sep. 1986 p 3-13 (For primary document see N87-16344 08-39)
Avail: NTIS HC A05/MF A01

The rationale for using random testing for distribution qualifications is examined. The test procedure is described, the principle of operation of digital controllers for random testing is outlined, and several commercial systems are evaluated with respect to the capabilities, specifications, and hardware and software features. Author

N87-16346# Ohio State Univ., Columbus. Dept. of Civil Engineering.
EARTH PENETRATION BY SOLID IMPACTORS c37
H. Adeli, A. M. Amin, and R. L. Sierakowski *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 9 Sep. 1986 p 15-22 (For primary document see N87-16344 08-39)
Avail: NTIS HC A05/MF A01

Prediction of earth penetration depth of solid impactors using analytical, semi-analytical, and empirical techniques is reviewed and summarized. A simple formula for predicting penetration depth in single-layered cohesive soils is proposed. The formula is compared with the Sandia and Kar formulas. Author

N87-16347# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 7 Monthly Report
Judith Nagle-Eshleman, ed. Jul. 1986 72 p
(AD-A173547) Avail: NTIS HC A04/MF A01

Work on substructure analysis and component mode synthesis of vibrating systems is summarized. Wave propagation in random composite materials is discussed. Investigations of dynamic response of random media since the late 1940's are reviewed. Abstracts from the current literature are given. For individual titles, see N87-16348 through N87-16349.

N87-16348# Tufts Univ., Medford, Mass. Dept. of Mechanical Engineering.
SUBSTRUCTURING AND COMPONENT MODE SYNTHESIS
R. Greif *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 7 Jul. 1986 p 3-8 (For primary document see N87-16347 08-39)
Avail: NTIS HC A04/MF A01

Work done since 1983 on substructure analysis and component mode synthesis of vibrating systems is summarized. Among the topics discussed are recent theoretical developments, error estimates due to truncation procedures, and damping synthesis. The discussion includes combined experimental/analytical modeling and applications to a variety of engineering problems. Author

N87-16349# Tel-Aviv Univ. (Israel). Center for Technological Education.
WAVE PROPAGATION IN RANDOM COMPOSITE MATERIALS c24
A. I. Beltzer *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 7 Jul. 1986 p 11-15 (For primary document see N87-16347 08-39)
Avail: NTIS HC A04/MF A01

Investigations of the dynamic response of random media since the late 1940s are reviewed. Attention is focused on linear theory; elastic response of composite materials is emphasized. Work concerned with polycrystals, fluids, and fluid-saturated media or electromagnetic waves is included because this has influenced developments in the field of elastic behavior of composites. Author

N87-16350# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 6 Monthly Report
Judith Nagle-Eshleman, ed. Jun. 1986 95 p
(AD-A169795) Avail: NTIS HC A05/MF A01

A review is given of the dynamic behavior of stiffened plates. Elastic wave propagation in beams with discontinuities of cross section is discussed. Abstracts from the current literature are given. For individual titles, see N87-16351 through N87-16352.

N87-16351# Indian Inst. of Tech., Kharagpur. Dept. of Naval Architecture.
A REVIEW OF DYNAMIC BEHAVIOR OF STIFFENED PLATES
A. Mukherjee and M. Mukhopadhyay *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 6 Jun. 1986 p 3-8 (For primary document see N87-16350 08-39)
Avail: NTIS HC A05/MF A01

A review is given of analytical and numerical tools for studying the dynamic behavior of stiffened plates. The various approaches include orthotropic plate approximation, grillage approximation, and plate and beam idealization. Author

N87-16352# Aberdeen Univ. (Scotland). Dept. of Engineering.
THEORETICAL STUDIES ON FLEXURAL WAVE PROPAGATION IN BEAMS: A COMPREHENSIVE REVIEW. PART 3: WAVE PROPAGATION IN BEAMS WITH DISCONTINUITIES OF CROSS SECTION
M. M. Al-Mousawi *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 6 Jun. 1986 p 11-18 (For primary document see N87-16350 08-39)
Avail: NTIS HC A05/MF A01

A comprehensive review is given of flexural wave propagation in beams. The historical background is given. The use of Timoshenko beam theory, including the effect of shear distortion and rotatory inertia, for vibrational and transient analysis of beams is described. Elastic stress wave propagation in beams with discontinuites of cross section is discussed. Author

N87-16353# Pennsylvania State Univ., University Park. Dept. of Mathematics.
STABILIZATION AND CONTROL PROBLEMS IN STRUCTURAL DYNAMICS Annual Report, 1 Sep. 1985 - 31 Mar. 1986
Goong Chen 28 May 1986 6 p
(Grant AF-AFOSR-0253-85)
(AD-A172069; AFOSR-86-0605TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The completed research includes significant accomplishments on such problems as the stabilization and control of serially connected beams, point actuators and sensors for second order systems, the boundary element numerical method for two simensional linear quadratic elliptic problems, quasi-variational inequalities, analysis and design of dissipative joints in structures, a boundary element method based on Cauchy integrals for some linear quadratic elliptic problems, and the stabilization of nonlinear strings. GRA

N87-16354# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
ELASTIC WAVE SCATTERING BY SURFACE-BREAKING PLANAR AND NON-PLANAR CRACKS
A. H. Shah, Y. F. Chin, and S. K. Datta Aug. 1986 17 p
(Contract N00014-86-K-0280)
(AD-A172130; CUMER-86-6) Avail: NTIS HC A02/MF A01 CSCL 14/2

At present ultrasonic techniques for characterizing defects are being explored vigorously at various research centers around the world. Currently, the ultrasonic approach to defect sizing and characterization is beginning to find great favor for in- or out-of-service use. A recent review of practical ultrasonic nondestructive evaluation is referred. Because of recent advances in experimental ultrasonic technology, increasing demands are being put on quantitative theoretical modeling of scattering of ultrasonic (elastic) waves by cracks, cavities and other material inhomogeneities in an elastic medium. With a view to obtain detailed information about signals scattered from complex defects various analytical and numerical techniques have emerged. In this article we present a combined finite elements and eigenfunction expansion technique for solving scattering problems involving multiple scattering as well as complex geometries. Numerical results obtained by this method are compared with recent experimental results. In the following we first summarize the theoretical treatment. Then we present the finite elements and eigenfunction expansion technique (FEEET). Numerical and experimental results are presented next. Although the results presented here are for homogeneous materials, the method can readily be extended to composite materials. GRA

N87-16355# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A MIXED COMPUTATIONAL ALGORITHM BASED ON THE UPDATED LAGRANGIAN DESCRIPTION FOR PLANE ELASTIC CONTACT PROBLEMS Interim Report
P. R. Heyliger and J. N. Reddy Aug. 1986 125 p
(Contract N00014-84-K-0552)
(AD-A172145; VPI-E-86-17; MECH-R-3-ONR) Avail: NTIS HC A06/MF A01 CSCL 12/1

A mixed variational formulation and associated finite element model are developed for the stress analysis of plane elastic bodies in contact and undergoing large deformations. The updated Lagrangian formulation is used to develop the incremental equations. The finite element model contains displacements and the components of the second Piola Kirchhoff stress tensor as the nodal degrees of freedom. Two different computational

algorithms are developed to analyze the separate cases of rigid pin and elastic pin. The procedure accounts for friction between the contacting bodies and the computational difficulties associated with the unknown contact area. A hybrid technique is also presented that combines the finite element procedure and the moire inteferometry to determine stresses in a pin-loaded plate. The procedure involves the use of the displacements measured in the experiment (moire technique) as boundary conditions at the pin hole interface of the finite element analysis. Then the whole field information of displacements and stresses is obtained using the finite element method. Results of this hybrid technique are compared with those obtained by the numerical algorithm with the results in good agreement. GRA

N87-16356# Naval Research Lab., Washington, D. C.
FRACTURE MECHANICS, STRAIN ENERGY DENSITY AND CRITICAL ISSUES FOR RESEARCH AND APPLICATIONS
Peter Matic and Mitchell I. Jolles 29 Aug. 1986 12 p
(AD-A172174; NRL-MR-5838) Avail: NTIS HC A02/MF A01 CSCL 20/11

This report is in response to a number of requests for a concise review of issues in fracture mechanics, the development of strain energy density concepts within the academic community, and the implications of these issues and concepts for fracture mechanics within the Navy. The authors have attempted to highlight the fundamental differences between various criteria and chronologically review the development of strain energy concepts. A brief description of research topics being pursued at the Naval Research Laboratory is provided. In this way, the reader is given the author's perspective leading to the selection of critical issues for fracture mechanics. The forthcoming report, Critical Issues and Directions for Fracture Mechanics and Structural Integrity, similar in format, will concentrate more on current activities and specific technical issues for future applications. GRA

N87-16357# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE COLLAPSE OF COMPOSITE CYLINDRICAL PANELS WITH VARIOUS CUTOUT LOCATIONS CONSIDERING MATERIAL DEGRADATION M.S. Thesis
Michael F. Hermsen Mar. 1986 154 p
(AD-A172440; AFIT/GAE-86M-2) Avail: NTIS HC A08/MF A01 CSCL 11/4

The purpose of this thesis is to study the effects of material degradation on panels with cutouts. To observe this effect, one first has to establish the critical positions of specific size cutouts within the panel. In order to do this, the effect of a cutout located at different positions within the composite cylindrical panel subjected to an axial loading will be studied analytically using the structural Analysis of General Shells (STAGSC-1) computer program. Then secondly, material degradation effects due to temperature and moisture at the critical cutout locations will be analyzed. Upon completion, this thesis will allow for a better understanding of axially loaded composite cylindrical shells with cutouts under less then perfect conditions. GRA

N87-16358# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
STRESS STATE AND HYDROGEN-RELATED FRACTURE
D. A. Koss and Fan Yunchang Sep. 1986 36 p
(Contract N00014-86-K-0381)
(AD-A172488; TR-2) Avail: NTIS HC A03/MF A01 CSCL 11/6

The influence of externally imposed stress state on the hydrogen-assisted fracture of metals is reviewed. Independent of any transport process which may result in hydrogen accumulation, the effects of stress state are to accelerate the hydrogen-related fracture processes with increasing triaxiality of stress state. The magnitude of the intrinsic sensitivity of hydrogen embrittlement to stress state effect depends on the mechanism of embrittlement. The behavior of selected hydride as well as non-hydride forming alloy systems is reviewed. GRA

N87-16359# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
VIBRATION CONTROL OF FLEXIBLE STRUCTURE USING PIEZOELECTRIC DEVICES AS SENSORS AND ACTUATORS Ph.D. Thesis
Michael W. Obal Sep. 1986 265 p
(AD-A172994; AFIT/CI/NR-86-176D) Avail: NTIS HC A12/MF A01 CSCL 09/5

The problem of the active control of linear elastic structures using piezoceramic transducers as sensors and actuators has been investigated by a combined theoretical and experimental approach. The optimal rate feedback gain distribution of an active structure with multiple collocated sensors and actuators has been obtained by using a limited state feedback approach which resulted in an increase in system damping. To model the active structure for the optimal control problem, a finite element model has been developed. An active element consisting of a simple beam element with a bonded unimorphic piezoceramic sensors and actuators has been obtained. The model incorporates the electromechanical coupling of the transducers, bonding effects and a mathematical model for the feedback signal conditioning circuitry. The resulting discrete degrees of freedom model is in the form of a set of coupled ordinary differential equations which describe the dynamic behavior of the active structure. To obtain the unknown dynamic coupling coefficients that represent the effects of bonding and other para meters of the model accurately, parameter identification methods have been used. GRA

N87-16360# New Mexico Univ., Albuquerque. Dept. of Mechanical Engineering.
STRUCTURE DYNAMIC THEORIES OF FRACTURE DIAGNOSIS Technical Report, Jan. - Dec. 1985
Frederick D. Ju 3 Mar. 1986 137 p
(Grant AF-AFOSR-0085-85)
(AD-A172732; ME-134(85)AFOSR-993-2; AFOSR-86-0890TR) Avail: NTIS HC A07/MF A01 CSCL 20/11

Two modal theories of damage diagnosis are presented. The modal frequency theory, based on the changes in a modal frequencies of a structure due to damage, can identify both the location and the intensity of a crack for simple fracture configurations. The transmissibility theory, which uses the changes in transmissibilities across a structure, is proposed as a feasible method for large structures. The report reveals the uncertainties of the modal frequency theory. The transmissibility theory is illustrated with a frame structure in localizing a fracture damage. GRA

N87-16361# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
THE INFLUENCE OF ELECTRIC CURRENT ON CRACK PROPAGATION IN THERMAL FATIGUE TESTS Final Report, 1 Aug. 1984 - 31 Jul. 1985
Jerry H. Griffin 17 Feb. 1986 44 p
(Grant AF-AFOSR-0203-84)
(AD-A172739; Rept-1-52113; AFOSR-86-0886TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

The use of a benchmark or model problem to estimate errors in stress intensity factors and local temperatures in thermal-mechanical fatigue testing which uses large electric currents for heating has shown that this mode of testing results in a more severe stress state than if conventional heating methods are used. The reason for the more severe stress state is that the application of a constant voltage across a cracked specimen results in a singular current and, consequently, a singular heat source. The singular heat source does not result in a temperature singularity, however, so the temperature remains bounded at the crack tip. The relative discrepancy between conventional heating fatigue testing and resistance heating fatigue is quite dependent on crack size and materials properties: primarily thermal and electrical conductivity and linear thermal expansion. Materials exhibiting low electrical resistance and high thermal expansion are, in general, more susceptible to this mode of thermal loading. Simple expressions for estimating the contribution of electric current to the stress intensity factor and local temperature field were developed.

These expressions are estimated in light of some basic assumptions made during problem formulation. The validity and consequence of some of these assumptions are discussed. GRA

N87-16362# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ON THE BUCKLING OF SANDWICH BEAMS CONTAINING AN UNBONDED REGION M.S. Thesis
Carl J. Frushon May 1986 130 p Sponsored in part by NSF
(AD-A173603; AFIT/CI/NR-86-185T) Avail: NTIS HC A07/MF A01 CSCL 11/6

This study involves a combined experimental and analytical analysis of the stability of a sandwich beam (overall length of 16.5 inches) with a partially unbonded faceplate. For simplicity, the beam considered was simply supported. Fully bonded beams as well as beams with unbonded lengths ranging from 0.5 to 5.0 inches were tested. Two failure regimes were observed. A distinct collapse load was evident in experiments with short unbond lengths (less than or = 2.0 inches). The loading histories of beams with longer unbond lengths (less than or = 3.0 inches) were found to be characterized by a limit load. In all cases, a transition form a symmetric to a nonsymmetric buckling shape occurred. The presence of the unbonded region was found to drastically reduce the load-carrying capacity of the sandwich structure. A power-law relationship was found between the unbond length and maximum load. The bonded sandwich beam was modeled as an assembly of three beams. This structure was assumed to be initially geometrically perfect. A solution was found numerically and began when the load within the unbonded faceplate was greater than the Euler buckling load for that section. Limit loads were predicted for all unbond lengths. The model was found to predict the failure load of a sandwich beam (unbond lengths less than or = 2.0 inches) to within 12.5%. GRA

N87-16363# Coastal Engineering Research Center, Vicksburg, Miss.
ANNUAL DATA SUMMARY FOR 1983 CERC (COASTAL ENGINEERING RESEARCH CENTER) FIELD RESEARCH FACILITY Final Report, 1983 - 1984
Herman C. Miller, William E. Grogg, Jr., Michael W. Leffler, C. R. Townsend, III, and Stephen C. Wheeler Sep. 1986 241 p
(AD-A173634; CERC-TR-86-9) Avail: NTIS HC A11/MF A01 CSCL 08/3

This report provides basic data and summaries for the measurements made during 1983 at the US Army Engineer Waterways Experiment Station Coastal Engineering Research Center's Field Research Facility in Duck, N.C. The report includes comparisons of the present years' data to prior years, and cumulative statistics from 1980 to the present. Summarized in this report are meteorological and oceanographic data, monthly bathymetric survey results, samples of quarterly aerial photography, and descriptions and hourly data for the storms that occurred during the year. Wave conditions were the highest since measurements began at the FRF. The year was highlighted by 24 storms that included the close passage of Tropical Storm Dean in September. GRA

N87-16364# General Dynamics Corp., Fort Worth, Tex.
ADVANCED DURABILITY ANALYSIS. VOLUME 3: FRACTOGRAPHIC TEST DATA Final Report, Oct. 1984 - Sep. 1985
D. E. Gordon, S. B. Kirschner, L. E. Brubaker, K. Koepsel, and S. D. Manning 1 Aug. 1986 245 p Prepared in cooperation with United Analysis Inc., Springfield, Va.
(Contract F33615-84-C-3208)
(AD-A173635; AFWAL-TR-86-3017-Vol-3) Avail: NTIS HC A11/MF A01 CSCL 20/11

This report contains the test results and raw fractographic data for over 180 fatigue cracks. Natural fatigue cracks were acquired in fastener holes in 7475-T7351 aluminum. Three specimen fastener hole configurations were considered: (1) open hole, (2) bolt-in-hole(passive), and (3) bolt load transfer. Both straight-bore and countersunk fastener holes were considered. Strain survey results for a double-reversed dog-bone specimen (designed for 15% bolt load transfer) are presented. The fractographic data in this report can be used to quantify the initial fatigue quality or equivalent initial flaw size(EIFS) cumulative distribution for clearance-fit fastener holes. These data can be used to determine the initial flaw size for the durability and damage tolerance analyses of mechanically fastened joints. GRA

N87-16365# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
CORROSION AND LOAD TRANSFER EFFECTS ON FATIGUE OF MECHANICALLY FASTENED JOINTS
E. U. Lee 3 Feb. 1986 47 p
(AD-A173802; NADC-86026-60) Avail: NTIS HC A03/MF A01 CSCL 20/11

To provide a technical basis for formulating a reliable service life prediction methodology of aircraft structures, it is essential to understand and quantify the load transfer effect on the fatigue behavior of mechanically fastened joints. The work presented in this report aims at characterizing the fatigue behavior of mechanically fastened joints and identifying the load transfer effect. With tests of low, medium, and high load transfer specimens of 7475-T7351 aluminum alloy, the fatigue crack initiation and growth, and the fracture behavior have been investigated, and the load transfer effect has been defined quantitatively. The results are compared to those of a zero load transfer specimen, reported previously. GRA

N87-16366# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
DAMPING 1986 PROCEDURES, VOLUME 2 Summary Report, Feb. 1984 - Feb. 1986
E. D. Pinson, D. W. Nicholson, M. G. Prasad, R. H. Lin, and B. K. Wada May 1986 614 p
(AD-A173950; AFWAL-TR-86-3059-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 20/11

Individual conference papers are presented. Some of the titles include: Damping Characteristics of the Solar Array Flight Experiment; Resonant Shift Modal Testing Method for Viscous Damping Coefficient Estimation; Prediction of Spacecraft Damping; On Orbit Flexible Body Parameter Identification for Space Station; Design and Analysis of the PACOSS Representative System; Robust Control Design for Vibration Suppression of Large Space Structures; Active Augmentation of a Passively Damped Representative Large Space System; Active Control for Vibration Damping; A New Approach to Modeling Linear Viscoelastic Damping for Space Structures; Expertimental Investigations Into Passive and Active Control Using Space Realized Techniques; Material Damping in Aluminum and Metal Matrix Materials; Material Damping in Space Structures; Specific Damping Capacity of Metal Matrix Composites in Tension Tension Fatigue; Response Suppression in Composite Sandwich Shells; Prediction of Material Damping of Laminated Polymer Matrix Composites; The Influence of Fiber Length and Fiber Orientation on Damping and Stiffness of Polymer Composite Materials; A Review of the Damping Mechanisms in Advanced Fiber Reinforced Plates; Damping Measurements by Hilbert Transform on Composite Materials; and A Comparison Among Damping Coefficients on Several Aerospace Composite Materials. GRA

N87-16367# Army Close Combat Armaments Center, Watervliet, N.Y.
ACOUSTOELASTIC EFFECTS IN AUTOFRETTAGED STEEL CYLINDERS Final Report
W. Scholz and J. Frankel Oct. 1986 22 p
(AD-A174127; ARCCB-TR-86034) Avail: NTIS HC A02/MF A01 CSCL 20/11

Residual stresses in short cylinder sections cut from autofrettaged larger steel tubes have been measured by means of the acoustoelastic effect. Ultrasonic shear waves polarized along the hoop and radial direction and propagating in the axial direction, as well as longitudinal waves, were used. Calibration specimens cut from similar type material were used to determine the velocity changes of longitudinal and shear waves propagating perpendicular to an applied stress. Third order elastic values were derived from

these measurements. Velocity measurements for zero applied stress along different axes of the cube-shaped calibration specimens indicate the presence of orthorhombic texture. Stress distributions and texture dependent effects within the cylinders have been determined. GRA

N87-16368# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
FUNDAMENTAL STUDIES IN FATIGUE AND FRACTURE MECHANICS, PHASE 1 Final Report, 15 Jan. 1985 - 14 Apr. 1986
G. B. Sinclair 7 Oct. 1986 88 p
(Grant AF-AFOSR-0030-85)
(AD-A174493; SM-86-13; AFOSR-86-1077TR) Avail: NTIS HC A05/MF A01 CSCL 20/11

The basic tenet of fracture mechanics is that the stress intensity factor, K, controls fracture and fatigue: here the former claim is critically examined. The underlying supporting argument - the original energy argument of Griffith and the more modern K-controlled region view - are considered. These considerations demonstrate that there are questionable assumptions in both, so that the viability of K as a damage parameter for fracture has to be established by the physical evidence. The first question then is whether or not the critical value of K, K sub Ic, is a material parameter: checking data shows it need not be. The second question is can the technology be usefully predictive, even in the most simple of situations: checking the data shows it to be unreliable in this role. At this time then, it remains to ask similar questions concerning the role of K in fatigue crack growth and, certainly for the monotonic loading case, develop alternatives: these are the objectives of the second phase of the program. GRA

N87-16369# Applied Research Associates, Inc., Albuquerque, N. Mex.
HIGH FREQUENCY ANALYSIS OF CIRCULAR ARCHES Final Report, Feb. 1985 - Feb. 1986
Douglas H. Merkle and Laurence D. Merkle Sep. 1986 101 p
(Contract F29601-85-C-0029)
(AD-A174503; Rept-5956; AFWL-TR-86-22) Avail: NTIS HC A06/MF A01 CSCL 13/13

This report presents the theory of the dynamic response of a linearly elastic, circular arch, including the effects of both shear deformation and rotary inertia. The arch central angle is arbitrary, and the end restraints are linearly elastic. The theory is extended to include linear viscoelastic behavior, in which both arch and end restraints are governed by the same single linear rate sensitivity parameter. GRA

N87-16370# Sandia National Labs., Livermore, Calif.
MECHANICAL TESTS ON ALUMINUM ALLOYS AMg6 AND 5456-0
W. A. Kawahara, J. J. Tötten, and J. S. Korellis Aug. 1986 27 p
(Contract DE-AC04-76DR-00789)
(DE86-014746; SAND-86-8231) Avail: NTIS HC A03/MF A01

This is a compilation of a preliminary series of mechanical tests performed on specimens extracted from 0.2 in. (5 mm) thick plates of annealed alloy AMg6 and its nearest US equivalent, 5456-0 at room temperature. Included are in-plane tensile data on strain rate sensitivity, quasistatic notched behavior and post-shock properties, and one attempt at spall suppression by back-surface hole drilling. DOE

N87-16371# Oak Ridge National Lab., Tenn. Div. of Engineering Technology.
DISLOCATION FREE ZONE MODEL OF FRACTURE UNDER REVERSE LOADING
S. J. Chang and S. M. Ohr (State Univ. of New York, Stony Brook.) 1986 22 p Presented at the 3rd Nonlinear Fracture-Mechanics Symposium, Knoxville, Tenn., 6 Oct. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000401; CONF-861043-2) Avail: NTIS HC A02/MF A01

We have shown previously that the presence of a dislocation free zone (DFZ) between a crack tip and its plastic zone is closely related to the condition for dislocation emission from the crack tip. The local stress intensity at the crack tip is shielded by the dislocations in the plastic zone from the applied stress and, therefore, its magnitude is reduced. Upon unloading, the existing dislocations serve to increase the magnitude of the reversed local stress intensity as a result of anti-shielding from the applied stress intensity. We have examined the effect of reverse loading and anti-shielding on the local stress intensity, the size of DFZ and the associated distribution functions of dislocations. It is shown in the numerical results that during reverse loading two distinct equilibrium distributions of dislocations are possible. The true distribution can be selected from the two if the local stress intensity factor is limited by the reversed critical stress intensity factor for dislocation emission -K/sub g/. The negative dislocations thus generated lead to crack growth for specimen subject to reverse loading or cyclic loading. DOE

N87-16372# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
DYNAMIC MOIRE INTERFEROMETRY STUDIES OF STRESS WAVE/CRACK TIP DIFFRACTION EVENTS IN 4340 STEELS
J. S. Epstein, V. A. Deason, and W. G. Reuter 30 Aug. 1986 49 p
(Contract DE-AC07-76ID-01570)
(DE87-000773; EGG-M-22785) Avail: NTIS HC A03/MF A01

A study of the stress wave propagation around localized crack tip regions in engineering materials is presented. The principal tool of this initial investigation is dynamic moire interferometry. Dynamic moire interferometry yields full field continuum boundary conditions of surface displacement in a real time optical processing manner. The displacement sensitivity employed for this study is 3.3 microns. However, the displacement sensitivity can be as sensitive as 0.2 microns. The spatial resolution developed is below a millimeter. After briefly reviewing the applied optics of dynamic moire interferometry, this paper reviews the case of a longitudinal pulse interacting with an artificial crack in a finite steel bar. The equations for the near tip elastic dynamic crack displacements are re-examined to extract localized elastic dynamic stress intensity factors in light of the capabilities of dynamic moire interferometry. DOE

N87-16373# National Bureau of Standards, Boulder, Colo. Fracture and Deformation Div.
CYCLE-COUNTING METHODS FOR FATIGUE ANALYSIS WITH RANDOM LOAD HISTORIES: A FORTRAN USER'S GUIDE
Y. W. Cheng and J. J. Broz Aug. 1986 52 p Sponsored by Minderals Management Service, Reston, VA.
(PB87-104758; NBSIR-86/3055) Avail: NTIS HC A04/MF A01 CSCL 20K

Rainflow and mean crossing-range methods are used in counting the stress ranges and cycles of a random load history. Each method is defined and then applied to a simple random load history example. Fortran computer programs were written to make analysis of long random load histories possible. The stress ranges and cycles obtained by these programs have been used for fatigue crack growth analysis under sea-wave loading. GRA

N87-16374# United Kingdom Atomic Energy Authority, Harwell (England). Materials Physics and Metallurgy Div.
MICROMECHANICAL MODELLING OF FRACTURE TOUGHNESS
P. Bowen (Cambridge Univ., England), S. G. Druce, and J. F. Knott Apr. 1986 33 p
(AERE-R-12216) Avail: NTIS HC A03/MF A01

Studies made on a wide range of microstructures in ASTM A533B pressure vessel steel, to explore the relationships between the critical stress intensity factor, K sub IC, and the microscopic (local) cleavage fracture stress, sigma sub F asterisk are discussed. The measured temperature dependence of the fracture toughness has been compared with that predicted by the Ritchie, Knott and Rice (RKR) micromechanical model. For most microstructures the fracture toughness predictions are poor but represent a lower bound to the experimental values. It is concluded that the fracture toughness at very low test temperatures, -196 C,

is controlled by the mean carbide size, while at higher test temperatures the fracture toughness is controlled by carbides of coarser size. The effect of temperature is therefore to change the sizes of carbides that can provide active (potent) microcrack nuclei. A limiting temperature, above which cleavage cannot occur, is predicted when the stress intensification in the process zone ahead of the crack tip is insufficient to propagate a micro-crack from the coarsest carbide. Author

N87-16375# United Kingdom Atomic Energy Authority, Harwell (England). Materials Physics and Metallurgy Div.
THE USE OF ALTERNATING CURRENT POTENTIAL DROP FOR DETERMINING J-CRACK GROWTH RESISTANCE CURVES
G. P. Gibson Feb. 1986 25 p
(AERE-R-12068) Avail: NTIS HC A02/MF A01

The use of the ac potential drop technique as a single specimen method for J-R curve determination has been investigated. The technique involves passing an alternating current through the specimen and relating the changes in the potential drop across the crack mouth to changes in crack length occurring during the test. Two approaches for analyzing the measured potential drop signals have been evaluated, one of which enables accurate J-R curves to be determined. In addition, the ac potential drop technique has been compared to the corresponding dc potential drop technique. In general both techniques can yield accurate J-R curves. Author

N87-16376# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
PRACTICAL APPLICATION OF FINITE ELEMENT ANALYSIS TO AIRCRAFT STRUCTURAL DESIGN
Loughton, England Aug. 1986 138 p Lectures held in Geilo, Norway, 11-12 Sep. 1986, in Lisbon, Portugal, 15-16 Sep. 1986, at McClellan AFB, Calif., 29-30 Sep. 1986, at Kelly AFB, Tex., 2-3 Oct. 1986, and at Wright-Patterson AFB, Ohio, 6-7 Oct. 1986 (AGARD-LS-147; ISBN-92-835-1536-6) Avail: NTIS HC A07/MF A01

This lecture introduces the main aspects of finite element analysis and modeling with emphasis placed on the solution of practical design problems. An outline is given of the broad principles of the finite element method with some emphasis on the limitations of the technique. This is followed by an explanation of the modeling problems encountered in the analysis of real structures together with their resolution. The use of the finite element system is included. For individual titles, see N87-16377 through N87-16380.

N87-16377# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
INTRODUCTION TO FINITE ELEMENT BASICS **c64**
A. J. Morris *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design Aug. 1986 35 p (For primary document see N87-16376 08-39)
Avail: NTIS HC A07/MF A01

A solution technique which is numerically stable, easily programmed and can be adapted to a wide range of problem types without excessive interference by the user is provided by the finite element method, from a structural viewpoint. The essence of the finite element method involves dividing the structure into a suitable number of small pieces called finite elements. The intersections of the sides of the elements occur at nodal points or nodes and the interference between elements are called nodal lines and nodal planes. For structural problems involving static or dynamic applied loads, the behavior of the structure is defined in terms of displacements and/or stresses. Within each of the elements a pattern or shape is selected for the unknown displacement or stress. In the case of a displacement field the shape function defines the behavior of displacements within an element in terms of unknown quantities specified at the element nodes. These nodal values are known as nodal connection quantities and allow the deformation behavior in one element to be communicated to adjacent elements. In the case of an assumed stress field in the element the connection quantities are different but the underlying principle is the same. E.R.

N87-16378# British Aerospace Aircraft Group, Warton (England).
STATING THE PROBLEM: THE STEP BEFORE F. E. MODELLING
Ian C. Taig *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design Aug. 1986 11 p (For primary document see N87-16376 08-39)
Avail: NTIS HC A07/MF A01

Structural analysis is concerned with finding practical solutions of physical problems in the real world; finite element analysis is one powerful tool used as part of this process. Before starting to set up a finite element analysis the task should be planned and the essential features of the real world problem should be identified. Seven steps are studied: planning the analysis in relation to resources available, definition of the real structure, description of the real structure, description of the structural context, definition of the facilities and resources available, and prescription of the solution requirements. In all cases, except formulation, these topics are dealt with discursively, without recourse to mathematics. In discussing formulation, a simple engineers theory of matrix structural analysis is presented as an everyday medium for defining and understanding the finite element solution process. Author

N87-16379# British Aerospace Aircraft Group, Warton (England). Military Aircraft Div.
MODELLING FOR THE FINITE ELEMENT METHOD
Ian C. Taig *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design Aug. 1986 18 p (For primary document see N87-16376 08-39)
Avail: NTIS HC A07/MF A01

Finite element modeling is not synonymous with mesh generation. The complex structures typical of aerospace, and many other industries give limited choice for clever mesh definition but contain a host of features which need to be represented, either explicitly or implicitly within the finite element model. Topics covered herein include general modeling strategy, definition of a basic mesh, local modeling of structural features including those which are below the basic mesh scale, element selection, load and inertial representation, kinematic constraints and symmetry. All topics are treated in a non-mathematical way, relating decisions which the analyst must make to the known facts about the analysis in the way that experienced people make such judgements. This naturally leads to references to expert systems which are seen as having a major impact in this field. Author

N87-16380# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THE USE OF THE FINITE ELEMENT METHOD
V. B. Venkayya *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design Aug. 1986 39 p (For primary document see N87-16376 08-39)
Avail: NTIS HC A07/MF A01

These lecture notes are primarily intended to provide a quick overview of the solid mechanics problem for engineers using a general purpose finite element system in the solution of aerospace structures problems. It gives a brief outline of the solid mechanics problem and some the available options for its solution. The finite element method is explained in more detail with particular emphasis on the use of membrane element in aerospace structural analysis. Author

N87-16031*# Harris Corp., Palm Bay, Fla.
MAST FLIGHT SYSTEM BEAM STRUCTURE AND BEAM STRUCTURAL PERFORMANCE
David C. Lenzi and John W. Shipley *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 265-279 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16032*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAST FLIGHT SYSTEM DYNAMIC PERFORMANCE
L. Davis, D. Hyland, T. Otten, and F. Ham *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 281-298 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16033*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAST FLIGHT SYSTEM OPERATIONS
M. Larry Brumfield *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 299-317 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COFS 3: MULTIBODY DYNAMICS AND CONTROL TECHNOLOGY
Robert Letchworth and Paul E. McGowan *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 347-370 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN CONSIDERATIONS FOR JOINTS IN DEPLOYABLE SPACE TRUSS STRUCTURES
Marvin D. Rhodes *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 383-398 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF MODAL IDENTIFICATION TECHNIQUES USING A HYBRID-DATA APPROACH
Richard S. Pappa *In its* NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 399-417 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 20K

N87-16745*# Alabama Univ., Birmingham. Dept. of Materials Engineering.
LOW GRAVITY CONTAINERLESS PROCESSING OF IMMISCIBLE GOLD RHODIUM ALLOYS
J. Barry Andrews *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20K

N87-16759*# John Brown Univ., Siloam Springs, Ark. Dept. of Mechanical Engineering.
THEORETICAL STUDIES ON THE MECHANICAL BEHAVIOR OF GRANULAR MATERIALS UNDER VERY LOW INTERGRANULAR STRESSES
Kenneth W. French, Jr. *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20K

42 GEOSCIENCES (GENERAL)

N87-16381*# Science Applications International Corp., Washington, D.C.
EARTH AND ENVIRONMENTAL SCIENCE IN THE 1980'S: PART 1: ENVIRONMENTAL DATA SYSTEMS, SUPERCOMPUTER FACILITIES AND NETWORKS
Washington NASA Oct. 1986 431 p
(Contracts NASw-3622; NASw-4092; SAIC Proj. 1-224-03-340-28) (NASA-CR-4029; NAS 1.26:4029) Avail: NTIS HC A19/MF A01 CSCL 08E

Overview descriptions of on-line environmental data systems, supercomputer facilities, and networks are presented. Each description addresses the concepts of content, capability, and user access relevant to the point of view of potential utilization by the Earth and environmental science community. The information on similar systems or facilities is presented in parallel fashion to encourage and facilitate intercomparison. In addition, summary sheets are given for each description, and a summary table precedes each section. Author

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N87-16382# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATION OF REMOTE SENSING IN HYDROLOGY AND WATER RESOURCES [APLICACOES DE SENSORIAMENTO REMOTO EM HIDROLOGIA E RECURSOS HIDRICOS]
Evlyn Marcia Leao deMoraes Novo Sep. 1986 14 p In PORTUGUESE Submitted for publication
(INPE-3986-PRE/991) Avail: NTIS HC A02/MF A01

Possible remote sensing data applications in the areas of hydrology and water resources are discussed. The principal field of activity and the electromagnetic spectrum band most used are analyzed first with research in the available bibliography. Also supplied are some examples of orbital data used to monitor water resources monitors as developed at INPE/MCT. Author

N87-16383*# California Univ., Berkeley. Dept. of Forestry and Resource Management.
DEVELOPMENT OF EOS-AIDED PROCEDURES FOR THE DETERMINATION OF THE WATER BALANCE OF HYDROLOGIC BUDGET OF A LARGE WATERSHED Semiannual Progress Report, 1 Aug. - 31 Dec. 1986
Russell G. Congalton, Randall W. Thomas, and Paul J. Zinke 31 Dec. 1986 15 p
(Grant NAGw-881)
(NASA-CR-180118; NAS 1.26:180118) Avail: NTIS HC A02/MF A01 CSCL 08H

Work focused on the acquisition of remotely sensed data for the 1985 to 1986 hydrogolic year; continuation of the field measurement program; continued acquisition and construction of passive microwave remote sensing instruments; a compilation of data necessary for an initial water balance computation; and participation with the EOS Simulataneity Team in reviewing the Feather River watershed as a possible site for a simultaneity experiment. B.G.

N87-16384# Texas Univ., Austin. Center for Space Research.
NROSS (NAVY REMOTE OCEAN SENSING SYSTEM) TRACKING NETWORK ANALYSIS
B. D. Tapley, J. C. Ries, and C. Rajasenan 1986 19 p
(Contract N00014-85-K-2034)
(AD-A172132) Avail: NTIS HC A02/MF A01 CSCL 04/2

One of the main objectives of the NROSS mission is the daily production of mesoscale feature maps of selected ocean areas. The NROSS payload will include a SEASAT-class altimeter for the production of these maps and a scatterometer to measure wind speed and direction over the oceans. These wind measurements will be used in conjunction with the precision altimetry from TOPEX to examine the relationship between ocean circulation and winds. The authors conclude that the applicability of a particular

tracking network would appear to depend strongly on orbit accuracy requirements. One- to two-meter radial orbit accuracies are fairly easily obtained with current gravity models and almost any tracking scenario if the arcs are long enough. However, if more accurate orbits are required, either the arcs must be shortened to reduce dynamical model error effects, the gravity models must be improved significantly, or some postlaunch gravity tuning is necessary. The latter technique can be successfully employed only if the tracking is fairly global, or geographically correlated errors will occur in the resulting geopotential field. In this case all the permanent sites and possibly many of the portable sites may be required. The same is true if the arcs are merely shortened, since there must be enough well distributed data to average out measurement model errors. Thus only the denser tracking networks are likely to provide radial orbit accuracies significantly below the 1 meter level. GRA

N87-16385# Analytic Sciences Corp., Reading, Mass.
TOPICS IN GEODETIC ALGORITHM RESEARCH Final Report, Jan. - Dec. 1985
Robert P. Corner, A. R. LeSchack, Karen M. Marks, and Kevin S. Tait 15 Aug. 1986 179 p
(Contract N00014-85-C-0134)
(AD-A172481; TASC-TR-5186-1) Avail: NTIS HC A09/MF A01 CSCL 08/5

The concept of geodetic algorithm is defined in the context of estimating and computing gravity field quantities of interest from available measured data. Examples of major categories of geodetic algorithms are given. These include classical integral evaluation methods, least-squares collocation, the contractor's GEOFAST technique, and Fourier transform methods. Also summarized and reviewed are algorithms and techniques considered in investigations by an International Association of Geodesy (IAG) Special Study Group. Detailed results are presented for numerical experiments with the GEOFAST algorithm applied to synthetic data, demonstrating the high accuracy and computational efficiency of this method. Various aspects of the treatment of terrain effects are considered, including relevant efforts and results of the IAG Special Study Group as well as new theoretical and experimental contributions by the contractor. GRA

N87-16386# Air Force Geophysics Lab., Hanscom AFB, Mass.
AN EXTENSION OF THE SPLIT WINDOW TECHNIQUE FOR THE RETRIEVAL OF PRECIPITABLE WATER
Thomas J. Kleespies and Larry M. McMillin 3 Oct. 1986 5 p
(AD-A173008; AFGL-TR-86-0201) Avail: NTIS HC A02/MF A01 CSCL 17/8

The split window technique has been demonstrated to be a viable method of removing effects of atmospheric attenuation in order to make a more accurate estimate of surface properties. This technique has also been used to estimate low level water vapor fields. In this paper we make an extension to the split window technique such that it is possible to estimate total precipitable water. The essence of the split window technique is making observations of the earth in two differentially absorbing windows. We extend this technique by making observations in the split window under conditions where the atmospheric contribution to the upwelling radiance is essentially invariant, but the surface contribution changes markedly. Under these conditions it is possible to write a set of simultaneous equations and solve them for the transmittance of the split window, and from that deduce the quantity of the primary absorber, water. The conditions under which this extension is valid basically fall under two catagories; that of variation in time, and that of variation in space. Consecutive observations of a land surface from a geosynchronous satellite during the heating cycle of the day would be one example. Another would be observations from either a geosynchronous or polar orbiting satellite of immediately adjacent land and water surfaces with contrasting skin temperatures. GRA

N87-16387# SRI International Corp., Menlo Park, Calif. Atmospheric Science Center.
DEVELOPMENT AND DEMONSTRATION OF ALARM (AIRBORNE LIDAR AGENT REMOTE MONITOR) Final Report
Edward E. Uthe, Bruce M. Morley, and Norm B. Nielsen Aug. 1986 125 p
(Contract DAAG29-82-K-0175)
(AD-A172886; ARO-18954.2-GS) Avail: NTIS HC A06/MF A01 CSCL 17/8

An airborne wavelength-tunable CO2 differential absorption lidar (DIAL) capable of making simultaneous measurements of atmospheric backscatter and surface-reflected energy has been developed and tested in a series of experiments. A data base of surface returns for a flight track that passed over ocean, farmland, urban, forest and grassland surfaces was collected for various lidar wavelengths and wavelength separations. The data show that highest correlation between two-wavelength surface returns occurs over land surfaces and the highest decorrelation over ocean surfaces-the DIAL sensitivity for detection of chemical agents based on surface returns is significantly better over land than ocean areas. The data also show that the highest decorrelation is associated with the highest reflectivity surfaces of ocean and urban areas, probably a result of specular reflection. The correlation of surface returns decreases with increasing wavelength separation over land areas but is nearly independent of wavelength separation over ocean areas. The airborne DIAL system was demonstrated for mapping the cross-plume gas concentration distribution resulting from a near-surface release of SF6. A new Fourier analysis method was used to improve single pulse-pair signal-to-noise ratios. GRA

N87-16388# Army Engineer Topographic Labs., Fort Belvoir, Va.
SPARSE AREA STEREO MATCHING EXPERIMENT
Michael A. Crombie Jul. 1986 34 p
(AD-A173601; ETL-0424) Avail: NTIS HC A03/MF A01 CSCL 08/2

The algorithm used in this experiment is considered by many to be state-of-the-art for calculating x-parallax over rural regions. Even so, its output must be refined in sparse areas in order to meet accuracy requirements. The major result of this experiment showed that x-parallax should be measured from digital imagery containing no more than 10 lone pairs per millimeter. The objective of this report is to find ways to improve the output of the X-parallax front-end processor without using information from other front-end processors, and without drastically revising the algorithm. Two approaches were tested, namely to provide to the processor image data most suitable for rural type matching and to use similar yet less demanding procedures in difficult areas. In the first case, stereo matching was performed with digital pictures containing up to 10 lp/mm of information, and in the second case large correlation windows were used on difficult points. The latter approach was performed with another DIAL program designed to measure corresponding points in a pass point mode. GRA

N87-16389# National Geodetic Survey, Rockville, Md.
RELATIVISTIC GEODESY
A. Bjerhammar Sep. 1986 51 p
(PB87-104543; NOAA-TR-NOS-118; NGS-36) Avail: NTIS HC A04/MF A01 CSCL 08E

Theoretical formulas for estimation of relativistic geopotential differences are given. Clock frequencies are found to be inversely proportional to the geopotential difference. Rigorously squared clock frequencies are inversely proportional to the g(oo)-elements of the metric tensor. The missing nondiagonal elements of the metric tensor in the Newtonian geopotential introduce a bias (from angular momentum) which is avoided in the relativistic approach. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N87-16390*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE 26TH PROJECT INTEGRATION MEETING Progress Report, Jul. 1985 - Apr. 1986
1986 697 p Meeting held in Pasadena, Calif., 29 Apr. - 1 May 1986 Sponsored by NASA
(NASA-CR-179926; JPL-Pub-86-23; DOE/JPL-1012-124; JPL-FSA-PR-26; NAS 1.26:179926) Avail: NTIS HC A99/MF E03 CSCL 10A

Progress made by the Flat-plate Solar Array (FSA) Project is described for the period July 1985 to April 1986. Included are reports on silicon sheet growth and characterization, silicon material, process development, high-efficienty cells, environmental isolation, engineering sciences, and reliability physics. Also included are technical and plenary presentations made at the 26th Project Integration Meeting (PIM) held on April 29 to 30 and May 1, 1986. For individual titles, see N87-16391 through N87-16444.

N87-16391*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AREA REPORTS. ADVANCED MATERIALS AND DEVICES RESEARCH AREA. SILICON MATERIALS RESEARCH TASK, AND ADVANCED SILICON SHEET TASK
In its Proceedings of the 26th Project Integration Meeting 1986 p 11-24 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The objectives of the Silicon Materials Task and the Advanced Silicon Sheet Task are to identify the critical technical barriers to low-cost silicon purification and sheet growth that must be overcome to produce a PV cell substrate material at a price consistent with Flat-plate Solar Array (FSA) Project objectives and to overcome these barriers by performing and supporting appropriate R&D. Progress reports are given on silicon refinement using silane, a chemical vapor transport process for purifying metallurgical grade silicon, silicon particle growth research, and modeling of silane pyrolysis in fluidized-bed reactors. R.J.F.

N87-16392*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVICE RESEARCH TASK (PROCESSING AND HIGH-EFFICIENCY SOLAR CELLS)
In its Proceedings of the 26th Project Integration Meeting 1986 p 25-35 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

This task has been expanded since the last 25th Project Integration Meeting (PIM) to include process research in addition to device research. The objective of this task is to assist the Flat-plate Solar Array (FSA) Project in meeting its near- and long-term goals by identifying and implementing research in the areas of device physics, device structures, measurement techniques, material-device interactions, and cell processing. The research efforts of this task are described and reflect the deversity of device research being conducted. All of the contracts being reported are either completed or near completion and culminate the device research efforts of the FSA Project. Optimazation methods and silicon solar cell numerical models, carrier transport and recombination parameters in heavily doped silicon, development and analysis of silicon solar cells of near 20% efficiency, and SiN sub x passivation of silicon surfaces are discussed. R.J.F.

N87-16393*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROJECT ANALYSIS AND INTEGRATION AREA
In its Proceedings of the 26th Project Integration Meeting 1986 p 37-39 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The objective of the Project Analysis and Integration Area (PA&I) is to support the planning, analysis, integration, and decision making activities of the Flat-plate Solar Array FSA) Project. Accordingly, PA&I supports the Project by developing and documenting Project plans based, in part, on the technical and economic assessments performed by PA&I of the various technical options. Goals for module technical performance and costs, derived from National Photovoltaics Program goals, are established by PA&I for each of the major technical activities in the Project. Assessments of progress toward achievement of goals are made to guide decision making within the Project. Author

N87-16394*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RELIABILITY AND ENGINEERING SCIENCES AREA. MATERIALS RESEARCH: SINGLE JUNCTION THIN FILM
In its Proceedings of the 26th Project Integration Meeting 1986 p 41-62 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A test bench was designed and fabricated for the purpose of improving control of hot-spot test accuracy. Electrochemical corrosion research focused on corrosion mechanisms to which both crystalline and a-Si modules may be subjected in central station applications. A variety of cells and several designs were subjected to accelerated stress tests. Humiditiy degradation rates were determined and key electrochemical failure mechanisms were identified. Software was developed for the prediction of power loss resulting from open circuits in an array field of a-Si modules. Failure analysis was continued on the four ARCO Solar Genesis modules. The interactions of water on the silicon module was examined. An autocatalytic photooxidation model was proposed. The reliability and durability of bonding materials and electrical insulation were also studied. B.G.

N87-16395*# Photovoltaic Energy Systems, Inc.
THE JET PROPULSION LABORATORY LOW-COST SOLAR ARRAY PROJECT, 1974-1986
P. D. Maycock *In* JPL, California Inst. of Tech. Proceedings of the 26th Project Integration Meeting 1986 p 91-95 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The overall objective of the photovoltaic program is to ensure that photovoltaic conversion systems play a significant role in the nation's energy supply by stimulating an industry capable of providing approximately 50 GWe of installed electricity generating capacity by the year 2000. In order to achieve this overall objective, several time-phased program goals have been defined. Near-term goals are to achieve photovoltaic flat-plate module or concentrator array prices of $2 per peak watt (1975 dollars) at an annual production rate of 20 peak megawatts in 1982. At this price level, energy costs should range from 100 to 200 mills/kwh. Mid-term goals are to achieve photovoltaic flat-plate module or concentrator array prices of $0.50 per peak watt (in 1975 dollars), and an annual production rate of 500 peak megawatts in 1986. Studies project that photovoltaic systems will begin to compete for both distributed and larger load-center utility-type applications and thereby open up significant markets for large-scale photovoltaic systems. Far term goals are to achieve the photovoltaic flat-plate module or concentrator array price goal of $0.10 to $0.30 per peak watt in 1990 (in 1975 dollars), and an annual production rate of 10 to 20 peak gigawatts in 2000. At this price range, energy cost should be in the range of 40 to 60 mills. kwh and be cost effective for utility applications. Achievement of these goals can make photovoltaic systems economically competitive with other energy sources for dispersed on-site applications as well as for central power generation. Author

N87-16396*# Spire Corp., Bedford, Mass.
HISTORICAL OVERVIEW, ACCOMPLISHMENTS, AND VALUE

OF THE FSA PROJECT: INDUSTRY
R. Little *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 97-105 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

An historical overview of the progress of photovoltaics (PV) as a function of oil price and DOE PV budgeting levels was presented. The state of the worldwide PV industry, the PV interests and activities of utilities, and the phases of evolution that a technology such a photovoltaics goes through on the way to commercialization were reviewed. Although the length of time it will take photovoltaics to evolve from discovery to commercialization was increased from 50 to 80 years, the outlook is optimistic. B.G.

N87-16397*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SILICON MATERIAL TASK REVIEW
J. H. Lorenz *In its* Proceedings of the 26th Project Integration Meeting 1986 p 107-116 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The objectives of the Flat-plate Solar Array (FSA) Project Silicon Material Task are to evaluate technologies, new and old; to develop the most promising technologies; to establish practicality of the processes to meet production, energy use, and economic criteria; and to develop an information base on impurities in polysilicon and to determine their effects on solar cell performance. The approach involves determining process feasibility, setting milestones for the forced selection of the processes, and establishing the technical readiness of the integrated process. Author

N87-16398*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
TECHNICAL PROGRESS IN SILICON SHEET GROWTH UNDER DOE/JPL FSA PROGRAM, 1975-1986
J. P. Kalejs *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 117-128 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The technical progress made in the Silicon Sheet Growth Program during its 11 years was reviewed. At present, in 1986, only two of the original 9 techniques have survived to the start-up, pilot-plant stage in industry. These two techniques are the edge-defined, film-fed growth (EFG) technique that produces closed shape polygons, and the WEB dendritic technique that produces single ribbons. Both the status and future concerns of the EFG and WEB techniques were discussed. B.G.

N87-16399*# Georgia Inst. of Tech., Atlanta.
A REVIEW OF HIGH-EFFICIENCY SILICON SOLAR CELLS
A. Rohatgi *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 129-137 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Various parameters that affect solar cell efficiency were discussed. It is not understood why solar cells produced from less expensive Czochralski (Cz) silicon are less efficient than cells fabricated from more expensive float-zone (Fz) silicon. Performance characteristics were presented for recently produced, high-efficient solar cells fabricated by Westinghouse Electric Corp., Spire Corp., University of New South Wales, and Stanford University. B.G.

N87-16400*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCESS RESEARCH AND DEVELOPMENT
D. B. Bickler *In its* Proceedings of the 26th Project Integration Meeting 1986 p 139-143 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The following major processes involved in the production of crystalline-silicon solar cells were discussed: surface preparation, junction formation, metallization, and assembly. The status of each of these processes, and the sequence in which these processes are applied, were described as they were in 1975, as they were in 1985, and what they might be in the future. B.G.

N87-16401*# Springborn Labs., Inc., Enfield, Conn.
JPL ENCAPSULATION TASK
P. Willis *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 145-156 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A detailed summary of the diverse encapsulation materials and techniques that evolved to meet the cost goals of the Flat-plate Solar Array (FSA) Project is presented. A typical solar cell now consists of low iron glass, two layers of ethylene vinyl acetate (EVA) polymers, a porous space, primers/adhesives, a back cover of Tedlar, and a gasket/seal for a volume cost of $1.30/sq ft. This compares well with the project goal of $1.40/sq ft. B.G.

N87-16402*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRYSTALLINE-SILICON PHOTOVOLTAICS SUMMARY MODULE DESIGN AND RELIABILITY
R. G. Ross, Jr. *In its* Proceedings of the 26th Project Integration Meeting 1986 p 157-163 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The evolution of the design and reliability of solar modules was described. Design requirements involved 14 different considerations, including residential building and material electrical codes, wind-loading, hail impact, operating temperature levels, module flammability, and interfaces for both the array structure and the operation of the system. Reliability research involved in diverse investigations including glass-fracture strength, soiling levels, electrochemical corrosion, and bypass-diode qualification tests. Based on these internationally recognized studies, performance assessments, and failure analyses, the Flat-plate Solar Array Project in its 11-year duration served to nuture the development of 45 different solar module designs from 15 PV manufacturers. B.G.

N87-16403*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROJECT ANALYSIS AND INTEGRATION ECONOMIC ANALYSES SUMMARY
H. L. Macomber *In its* Proceedings of the 26th Project Integration Meeting 1986 p 167-176 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

An economic-analysis summary was presented for the manufacture of crystalline-silicon modules involving silicon ingot/sheet, growth, slicing, cell manufacture, and module assembly. Economic analyses provided: useful quantitative aspects for complex decision-making to the Flat-plate Solar Array (FSA) Project; yardsticks for design and performance to industry; and demonstration of how to evaluate and understand the worth of research and development both to JPL and other government agencies and programs. It was concluded that future research and development funds for photovoltaics must be provided by the Federal Government because the solar industry today does not reap enough profits from its present-day sales of photovoltaic equipment. B.G.

N87-16404*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CELL TECHNOLOGY: ADVANCED SILICON SHEET
Andrew D. Morrison *In its* Proceedings of the 26th Project Integration Meeting 1986 p 199-221 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The Flat-plate Solar Array (FSA)-sponsored Fourth Silicon Stress/Strain Workshop reviewed, coordinated, and assessed the progress in understanding and controlling stress and strain during the crystal growth of silicon ribbons. dislocation electrical activity and limits on solar cell efficiency, and on studying the effects of dopants on EFG characteristics. Work on silicon for high-efficiency

solar cells, stress-strain relationships in silicon ribbon, and high temperature deformation of dendritic web ribbon was also discussed.

N87-16405*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL WEB TEAM
D. B. Bickler *In its* Proceedings of the 26th Project Integration Meeting 1986 p 223-228 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The Jet Propulsion Laboratory (JPL) WEB Team activities were reported for activities which were directed toward identifying and attacking areas in the growth of dendritic web ribbon, to complement the program at Westinghouse Electric Corp. B.G.

N87-16406*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
STRESS AND EFFICIENCY STUDIES IN EDGE-DEFINED FILM-FED GROWTH
J. Kalejs *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 229-240 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The progress was reviewed for stress and efficiency studies of edge-defined film-fed growth (EFG) material. Effort was concentrated on the definition of conditions that will reduce stress, on quantifying dislocation electrical activity and limits on solar cell efficiency, and on studying the effects of dopants on EFG characteristics. B.G.

N87-16407*# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
HIGH-PURITY SILICON CRYSTAL GROWTH INVESTIGATIONS
T. F. Ciszek, T. Schuyler, J. L. Hurd, M. Fearheiley, C. Evans, and R. Elder *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 241-254 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Information is given on evaporation and segregation contributions to impurity profiles of floating zone crystals (FZ); high-purity silicon float zoning (FZ); minority-carrier lifetime measurement of heavily doped silicon crystals; the effect of some crystal growth parameters on minority-carrier lifetime; and defect investigations by X-ray topography in graphical and tabular form. It was concluded that evaporation contributes substantially to impurity reduction when FZ or cold-crucible growth is conducted in a vacuum; boron and gallium may be more favorable dopants than indium or aluminum for obtaining high minority-carrier lifetimes; minority-carrier lifetimes greater than 100 microseconds are feasible at a 2 times 10 to the 17th power cm-3 doping level; minority-carrier lifetime decreases with increasing crystal cooling rate and also with the presence of dislocations; the method used to clean silicon feed rods affects lifetime; and microdefect densities in dislocation-free FZ crystals appear to be lower with Ga doping than with B doping. R.J.F.

N87-16408*# Kentucky Univ., Lexington.
ANALYSIS OF SILICON STRESS/STRAIN RELATIONSHIPS
O. Dillon *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 255-284 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Results are presented for work on stress-strain relationships in silicon ribbon. Calculations of stress fields, dislocation desities, and buckling were made; uniaxial tensile tests were made on silicon at 1150 C; and dislocation motion studies were performed. B.G.

N87-16409*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SILICON STRESS/STRAIN ACTIVITIES AT JPL
C. P. Chen *In its* Proceedings of the 26th Project Integration Meeting 1986 p 285-296 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

In-house Jet Propulsion Laboratory (JPL) work is described for silicon stress/strain, including the study of fracture mechanics, and on the high-temperature test program in which the low-strain response of silicon sheet materials above 1000 C is being measured and high temperature material property data are being determined. B.G.

N87-16410*# Cornell Univ., Ithaca, N.Y.
CREEP OF WEB RIBBONS
S. Hyland and D. G. Ast *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 297-306 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Results are reported for work in high-temperature deformatin of dendritic web ribbons, and oxygen measurement in the material. B.G.

N87-16411*# Illinois Univ., Chicago.
SURFACE PROPERTY MODIFICATION OF SEMICONDUCTORS BY FLUID ABSORPTION
S. Danyluk *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 307-317 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The University of Illinois at Chicago program to develop an understanding of the basic mechanisms of deformation during the lubricated cutting of silicon is discussed. Also described is the development of a nondestructive measurement technique for residual stress in a silicon sheet. B.G.

N87-16412*# Washington Univ., St. Louis, Mo. Chemical Reaction Engineering Lab.
CZOCHRALSKI CRYSTAL GROWTH: MODELING STUDY
M. P. Dudukovic, P. A. Ramachandran, R. K. Srivastava, and D. Dorsey *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 319-328 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The modeling study of Czochralski (Cz) crystal growth is reported. The approach was to relate in a quantitative manner, using models based on first priniciples, crystal quality to operating conditions and geometric variables. The finite element method is used for all calculations. B.G.

N87-16413*# California Univ., Los Angeles.
OPTIMIZATION METHODS AND SILICON SOLAR CELL NUMERICAL MODELS
K. Girardini *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 331-343 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The goal of this project is the development of an optimization algorithm for use with a solar cell model. It is possible to simultaneously vary design variables such as impurity concentrations, front junction depth, back junctions depth, and cell thickness to maximize the predicted cell efficiency. An optimization algorithm has been developed and interfaced with the Solar Cell Analysis Program in 1 Dimension (SCAPID). SCAPID uses finite difference methods to solve the differential equations which, along with several relations from the physics of semiconductors, describe mathematically the operation of a solar cell. A major obstacle is that the numerical methods used in SCAPID require a significant amount of computer time, and during an optimization the model is called iteratively until the design variables converge to the value associated with the maximum efficiency. This problem has been alleviated by designing an optimization code specifically for use with numerically intensive simulations, to reduce the number of times the efficiency has to be calculated to achieve convergence to the optimal solution. Adapting SCAPID so that it could be called iteratively by the optimization code provided another means of reducing the cpu time required to complete an optimization. Instead

of calculating the entire I-V curve, as is usually done in SCAPID, only the efficiency is calculated (maximum power voltage and current) and the solution from previous calculations is used to initiate the next solution. Author

N87-16414*# Pennsylvania Univ., Philadelphia.
NOVEL MEASUREMENT TECHNIQUES (DEVELOPMENT AND ANALYSIS OF SILICON SOLAR CELLS NEAR 20% EFFCIENCY)
M. Wolf and M. Newhouse *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 345-355 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Work in identifying, developing, and analyzing techniques for measuring bulk recombination rates, and surface recombination velocities and rates in all regions of high-efficiency silicon solar cells is presented. The accuracy of the previously developed DC measurement system was improved by adding blocked interference filters. The system was further automated by writing software that completely samples the unkown solar cell regions with data of numerous recombination velocity and lifetime pairs. The results can be displayed in three dimensions and the best fit can be found numerically using the simplex minimization algorithm. Also described is a theoretical methodology to analyze and compare existing dynamic measurement techniques. B.G.

N87-16415*# Stanford Univ., Calif.
MEASUREMENT OF MINORITY CARRIER LIFETIME, MOBILITY AND DIFFUSION LENGTH IN HEAVILY DOPED SILICON
S. E. Swirhun and R. M. Swanson *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 357-366 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Carrier transport and recombination parameters in heavily doped silicon were examined. Data were presented for carrier diffusivity in both p- and n-type heavily doped silicon covering a broad range of doping concentrations from 10 to the 15th power to 10 to the 20th power atoms/cu cm. One of the highlights of the results showed that minority carrier diffusivities are higher by a factor of 2 in silicon compared to majority carrier diffusivities. B.G.

N87-16416*# Stanford Univ., Calif.
POINT CONTACT SILICON SOLAR CELLS
R. M. Swanson *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 367-373 Sponsored in part by Electric Power Research Inst., and DOE (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The construction of a 22.2% efficient single-crystal silicon solar cell fabricated at Stanford University is described. The cell dimensions were 3 x 5 mm and 100 microns thick with a base lifetime of 500 microseconds. The cell featured light trapping between a texturized top surface and a reflective bottom surface, small point contact diffusions, alternating between n-type and p-type in a polka-dot pattern on the bottom surface, and a surface passivation on all surfaces between contact regions. B.G.

N87-16417*# Washington Univ., Seattle.
SIN SUB x PASSIVATION OF SILICON SURFACES
L. C. Olsen *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 375-382 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The objectives were to perform surface characterization of high efficiency n+/p and p+/n silicon cells, to relate surface density to substrate dopant concentration, and to identify dominant current loss mechanisms in high efficiency cells. The approach was to measure density of states on homogeneously doped substrates with high frequency C-V and Al/SiN sub x/Si structures; to investigate density of states and photoresponse of high efficiency N+/P and P+/N cells; and to conduct I-V-T studies to identify current loss nechanisms in high efficiency cells. Results are given in tables and graphs. R.J.F.

N87-16418*# Westinghouse Research and Development Center, Pittsburgh, Pa.
DEVELOPMENT OF HIGH-EFFICIENCY SOLAR CELLS ON SILICON WEB
D. L. Meier *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 383-400 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Achievement of higher efficiency cells by directing efforts toward identifying carrier loss mechanisms; design of cell structures; and development of processing techniques are described. Use of techniques such as deep-level transient spectroscopy (DLTS), laser-beam-induced current (LBIC), and transmission electron microscopy (TEM) indicated that dislocations in web material rather than twin planes were primarily responsible for limiting diffusion lengths in the web. Lifetimes and cell efficiencies can be improved from 19 to 120 microns, and 8 to 10.3% (no AR), respectively, by implanting hydrogen at 1500 eV and a beam current density of 2.0 mA/sq cm. Some of the processing improvements included use of a double-layer AR coating (ZnS and MgF2) and an addition of an aluminum back surface reflectors. Cells of more than 16% efficiency were achieved. B.G.

N87-16419*# California Inst. of Tech., Pasadena.
AMOSPHOUS DIFFUSION BARRIERS
E. Kolawa, F. C. T. So, and M-A. Nicolet *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 403-408 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Amorphous W-Zr and W-N alloys were investigated as diffusion barriers in silicon metallization schemes. Data were presented showing that amorphous W-Zr crystallizes at 900 C, which is 200 C higher than amorphous W-Ni films, and that both films react with metallic overlayers at temperatures far below the crystllization temperature. Also, W-N alloys (crystalline temperature of 600 C) were successfully incorporated as a diffusion barrier in contact structures with both Al and Ag overlayers. The thermal stability of the electrical characteristics of shallow n(+)p junctions significantly improved by incorporating W-N layers in the contact system. One important fact demonstated was the critical influence of the deposition parameters during formation of these carriers. B.G.

N87-16420*# Electrink, Inc.
METALLO-ORGANIC DECOMPOSITION (MOD) FILM DEVELOPMENT
J. Parker *In* JPL, California Inst. of Tech. Proceedings of the 26th Project Integration Meeting 1986 p 409 - 417 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The processing techniques and problems encountered in formulating metallo-organic decomposition (MOD) films used in contracting structures for thin solar cells are described. The use of thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) techniques performed at Jet Propulsion Laboratory (JPL) in understanding the decomposition reactions lead to improvements in process procedures. The characteristics of the available MOD films were described in detail. B.G.

N87-16421*# Purdue Univ., West Lafayette, Ind.
INK-JET PRINTING OF SILVER METALLIZATION FOR PHOTOVOLTAICS
R. W. Vest *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 419-436 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The status of the ink-jet printing program at Purdue University is described. The drop-on-demand printing system was modified to use metallo-organic decomposition (MOD) inks. Also, an IBM

AT computer was integrated into the ink-jet printer system to provide operational functions and contact pattern configuration. The integration of the ink-jet printing system, problems encountered, and solutions derived were described in detail. The status of ink-jet printing using a MOD ink was discussed. The ink contained silver neodecanate and bismuth 2-ethylhexanoate dissolved in toluene; the MOD ink decomposition products being 99 wt% AG, and 1 wt% Bi. B.G.

N87-16422*# Westinghouse Research and Development Center, Pittsburgh, Pa.

LASER-ASSISTED SOLAR CELL METALLIZATION PROCESSING

D. L. Meier *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 437-450 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The status of the laser-assisted solar cell metallization processing is described. Metallo-organic silver films were spun-on by argon ion laser beam pyrolysis. The metallo-organic decomposition (MOD) film was spun-on an evaporated Ti/Pd film to produce tood adhesion. In a maskless process, the argon ion laser writes the contact pattern. The film is then built up to obtain the required conductivity using conventional silverplating process. The Ti/Pd film in the field is chemically etched using the plated silver film as the mask. The width of the contact pattern is determined by the power of the laser. Widths as thin as 20 microns were obtained using 0.66 W of laser power. Cells fabricated with the 50 micron line widths of 4 ohm-cm floating zone (Fz) silicon-produced efficiencies of 16.6% (no passivation) which were equivalent to the best cells using conventional metallization/lithography and no passivation. B.G.

N87-16423*# Westinghouse Research and Development Center, Pittsburgh, Pa.

PROCESS RESEARCH OF NON-CZOCHRALSKI SILICON MATERIAL

R. B. Campbell *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 451-459 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

Simultaneous diffusion of liquid precursors containing phosphorus and boron into dendritic web silicon to form solar cell structures was investigated. A simultaneous junction formation techniques was developed. It was determined that to produce high quality cells, an annealing cycle (nominal 800 C for 30 min) should follow the diffusion process to anneal quenched-in defects. Two ohm-cm n-base cells were fabricated with efficiencies greater than 15%. A cost analysis indicated that the simultansous diffusion process costs can be as low as 65% of the costs of the sequential diffusion process. B.G.

N87-16424*# North Carolina State Univ., Raleigh.

RAPID THERMAL PROCESSING OF CZOCHRALSKI SILICON SUBSTRATES: DEFECTS, DENUDED ZONES, AND MINORITY CARRIER LIFETIME

G. S. Rozgonyi, D. K. Yang, Y. H. Cao, and Z. Radzimski *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 461-471 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

Rapid thermal processing (RTP) of Czochralski (Cz) silicon substrates is discussed with its attendant effects on defects, denuded zones, and minority carrier lifetime. Preferential chemical etching and X-ray topography was used to delineate defects which were subsequently correlated with minority carrier lifetime; determined by a pulse metallo-organic decompositon (MOD) test device. The X-ray delineation of grown-in defects was enhanced by a lithium decoration procedure. Results, thus far, show excellent correlation between process-induced defects. B.G.

N87-16425*# Pennsylvania State Univ., University Park.

USE OF LOW-ENERGY HYDROGEN ION IMPLANTS IN HIGH-EFFICIENCY CRYSTALLINE-SILICON SOLAR CELLS

S. J. Fonash, R. Sigh, and H. C. Mu *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 473-481 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The use of low-energy hydrogen implants in the fabrication of high-efficiency crystalline silicon solar cells was investigated. Low-energy hydrogen implants result in hydrogen-caused effects in all three regions of a solar cell: emitter, space charge region, and base. In web, Czochralski (Cz), and floating zone (Fz) material, low-energy hydrogen implants reduced surface recombination velocity. In all three, the implants passivated the space charge region recombination centers. It was established that hydrogen implants can alter the diffusion properties of ion-implanted boron in silicon, but not ion-implated arsenic. B.G.

N87-16426*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LOW-PRESSURE, CHEMICAL VAPOR DEPOSITION POLYSILICON

B. D. Gallagher and G. C. Crotty *In its* Proceedings of the 26th Project Integration Meeting 1986 p 483-487 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The low-pressure chemical vapor deposition (LPCVD) of polycrystalline silicon was investigted. The physical system was described, as was the controlling process parameters and requirements for producing films for use as an integral portion of the solar cell contact system. B.G.

N87-16427*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ACCURACY AND LONG-TERM STABILITY OF AMORPHOUS-SILICON MEASUREMENTS

R. Mueller *In its* Proceedings of the 26th Project Integration Meeting 1986 p 491-496 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The measurement system requirements to obtain accurate electrical performance measurements of amorphous silicon cells and modules were described. The progress achieved in modifying the Jet Propulsion Laboratory (JPL) system toward that objective were reviewed. B.G.

N87-16428*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LONG-TERM STABILITY OF AMORPHOUS-SILICON MODULES

R. G. Ross, Jr. *In its* Proceedings of the 26th Project Integration Meeting 1986 p 497-503 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The Jet Propulsion Laboratory (JPL) program of developing qualification tests necessary for amorphous silicon modules, including appropriate accelerated environmental tests reveal degradation due to illumination. Data were given which showed the results of temperature-controlled field tests and accelerated tests in an environmental chamber. B.G.

N87-16429*# Clemson Univ., S.C. Solar Cell Destruction Lab.

SOLAR CELL RELIABILITY TESTING

J. Lathrop *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 505-518 (For primary document see N87-16390 08-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The progress and initial data on accelerated stress tests on small amorphous silicon test samples from several manufacturers are reported. The test samples include both single and tandem junction devices. B.G.

N87-16430*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LONG-TERM MODULE TESTING AT WYLE LABORATORIES

D. H. Otth *In its* Proceedings of the 26th Project Integration Meeting 1986 p 519-524 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Results are presented for a current set of accelerated long-term endurance tests on crystalline silicon module of various constructions. Cell materials include single crystal, semicrystal, EFG ribbon, and dendritic web ribbon. The latest data set is for the equivalent of 20-year life and showed satisfactory performance. B.G.

N87-16431*# Springborn Labs., Inc., Enfield, Conn.
MODULE ENCAPSULATION TECHNOLOGY
P. Willis *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 525-548 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The identification and development techniques for low-cost module encapsulation materials were reviewed. Test results were displayed for a variety of materials. The improved prospects for modeling encapsulation systems for life prediction were reported. B.G.

N87-16432*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COMMERCIAL MODULE TEST PROGRAM
M. I. Smokler *In its* Proceedings of the 26th Project Integration Meeting 1986 p 549-555 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The results are presented for a program of qualification testing of commercial crystalline silicon modules from nine manufacturers in five countries. The outcome demonstrated the effective role of the Block 5 Qualification Tests in the development of reliable modules. B.G.

N87-16433*# Spire Corp., Bedford, Mass.
HIGH-EFFICIENCY MODULE DESIGN
M. B. Spitzer *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 557-566 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Success was reported in meeting the long-sought goal of manufacturing a crystalline silicon module with efficiency of 15% or better. Encapsulated cell efficiencies as high as 17.6% were obtained. B.G.

N87-16434*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MEASURING RESEARCH PROGRESS IN PHOTOVOLTAICS
B. Jackson and P. McGuire *In its* Proceedings of the 26th Project Integration Meeting 1986 p 567-575 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The role and some results of the project analysis and integration function in the Flat-plate Solar Array (FSA) Project are presented. Activities included supporting the decision-making process, preparation of plans for project direction, setting goals for project activities, measuring progress within the project, and the development and maintenance of analytical models. B.G.

N87-16435*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MECHANISTIC STUDIES OF PHOTOTHERMAL AGING
R. H. Liang *In its* Proceedings of the 26th Project Integration Meeting 1986 p 581-589 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Cracks were observed forming in Tedlar back cover films on PV modules mounted outdoors in the natural environment. The cracks appear to approximate reasonable straight lines and, in general, are parallel to each other. It is implied that the directionality of these cracks may be in some way related to film orientation. Preliminary results from the Jet Propulsion Laboratory (JPL) studies investigating the causes of these cracks indicate that Tedlar does not become brittle on aging. It was speculated that perhaps compounding ingredients employed in EVA may migrate into the Tedlar film, thus causing a potential for chemical effects. B.G.

N87-16436*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
UV-T-RH COMBINED ENVIRONMENTAL TESTING
C. C. Gonzalez *In its* Proceedings of the 26th Project Integration Meeting 1986 p 591-597 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A combined environmental aging chamber was developed at the Jet Propulsion Laboratory (JPL). The chamber has an ultraviolet (UV) light source that can be varied between 1 to 2 suns, temperature control from -40 to +175 C, and adjustable humidity. Results from two initial aging experiments (Tedlar and amorphous silicon colar cells) were presented. B.G.

N87-16437*# Toronto Univ. (Ontario).
COMPUTER MODELING OF PHOTODEGRADATION
J. Guillet *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 599-614 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A computer program to simulate the photodegradation of materials exposed to terrestrial weathering environments is being developed. Input parameters would include the solar spectrum, the daily levels and variations of temperature and relative humidity, and materials such as EVA. A brief description of the program, its operating principles, and how it works was initially described. After that, the presentation focuses on the recent work of simulating aging in a normal, terrestrial day-night cycle. This is significant, as almost all accelerated aging schemes maintain a constant light illumination without a dark cycle, and this may be a critical factor not included in acceleration aging schemes. For outdoor aging, the computer model is indicating that the night dark cycle has a dramatic influence on the chemistry of photothermal degradation, and hints that a dark cycle may be needed in an accelerated aging scheme. B.G.

N87-16438*# Dow Corning Corp., Midland, Mich.
CHEMICAL BONDING TECHNOLOGY
E. Plueddemann *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 615-620 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Primers employed in bonding together the various material interfaces in a photovoltaic module are being developed. The approach develops interfacial adhesion by generating actual chemical bonds between the various materials bonded together. The current status of the program is described along with the progress toward developing two general purpose primers for ethylene vinyl acetate (EVA), one for glass and metals, and another for plastic films. B.G.

N87-16439*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANTICORROSION STUDIES
J. Boerio *In its* Proceedings of the 26th Project Integration Meeting 1986 p 621-627 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The aging behavior of chemically bonded interfaces between metals and pottants, such as ethylene vinyl acetate (EVA) was studied using the Dow Corning primer systems. It was observed that the primers seem to function as anticorrosive agents on metal surfaces. It was demonstrated that EVA, and the A-11861 EVA/glass primer stops corrosion of the aluminum used on the back surfaces of crystalline silicon solar cells. However, this same treatment does not work for the aluminum on the back surfaces of amorphous silicon solar cells. B.G.

N87-16440*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ELECTROCHEMICAL AGING EFFECTS IN PHOTOVOLTAIC MODULES
G. R. Mon *In its* Proceedings of the 26th Project Integration Meeting 1986 p 629-645 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Leakage currents were experimentally measured in PV modules undergoing natural aging outdoors, and in PV modules undergoing accelerated aging in laboratory environmental chambers. The significant contributors to module leakage current were identified with a long range goal to develop techniques to reduce or stop module leakage currents. For outdoor aging in general, module leakage current is relatively insensitive to temperature fluctuations, but is very sensitive to moisture effects such as dew, precipitation, and fluctuations in relative humidity. Comparing ethylene vinyl acetate (EVA) and polyvinyl butyral (PVB), module leakage currents are much higher in PVB as compared to EVA for all environmental conditions investigated. Leakage currents proceed in series along two paths, bulk conduction followed by interfacial (surfaces) conduction. B.G.

N87-16441*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LEAKAGE-CURRENT PROPERTIES OF ENCAPSULANTS
L. C. Wen *In its* Proceedings of the 26th Project Integration Meeting 1986 p 647-657 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A theoretical modeling of leakage current in ethylene vinyl acetate (EVA) and polyvinyl butyral (PVB) modules is being developed and is described. The modeling effort derives mathematical relationships for the bulk and surface conductivites of EVA and PVB, the surface conductivities of glass and polymeric films, and the EVA and PVB pottants, all as functions of environmental parameters. Results from the modeling indicate that for glass/EVA, the glass surface controls the interfacial conductivity, although EVA bulk conductivity controls total leakage current. For PVB/glass, the interface conductivity controls leakage currents for relative humidity (RH) less than 40 to 50%, but PVB bulk conductivity controls leakage current above 50% RH. B.G.

N87-16442*# Wilkes Coll., Wilkes-Barre, Pa.
WATER PERMEATION AND ELECTRICAL PROPERTIES OF POTTANTS, BACKINGS, AND POTTANT/BACKING COMPOSITES
J. Orehotsky *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 659-676 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

It is reported that the interface between plastic film back covers and ethylene vinyl acetates (EVA) or polyvinyl butyral (PVB) in photovoltaic modules can influence water permeation, and electrial properties of the composites such as leakage current and dielectric constant. The interface can either be one of two dissimilar materials in physical contact with no intermixing, or the interface can constitute a thin zone which is an interphase of the two materials having a gradient composition from one material to the other. The former condition is described as a discrete interface. A discrete interface model was developed to predict water permeation, dielectric strength, and leakage current for EVA, ethylene methyl acrylate (EMA), and PVB coupled to Tedlar and mylar films. Experimental data was compared with predicted data. B.G.

N87-16443*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REVIEW OF THE WORKSHOP ON LOW-COST POLYSILICON FOR TERRESTRIAL PHOTOVOLTAIC SOLAR CELL APPLICATIONS
R. Lutwack *In its* Proceedings of the 26th Project Integration Meeting 1986 p 679-685 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Topics reviewed include: polysilicon material requirements; effects of impurities; requirements for high-efficiency solar cells; economics; development of silane processes; fluidized-bed processor development; silicon purification; and marketing. B.G.

N87-16444*# Union Carbide Corp., New York.
POLYCRYSTALLINE SILICON RESEARCH AND DEVELOPMENT
S. Iya *In* JPL, California Inst. of Tech., Pasadena Proceedings of the 26th Project Integration Meeting 1986 p 687-692 (For primary document see N87-16390 08-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The development of fluidized-bed reactor technology for producing silicon by the pyrolysis of silanes is described. B.G.

N87-16445*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INITIAL PERFORMANCE OF ADVANCED DESIGNS FOR IPV NICKEL-HYDROGEN CELLS
John J. Smithrick Sep. 1986 13 p Presented at the 15th International Power Sources Symposium, Brighton, England, 7-11 Sep. 1986 Supersedes NASA-TM-87029
(NASA-TM-87282; E-2992; NAS 1.15:87282) Avail: NTIS HC A02/MF A01 CSCL 10C

Advanced designs for individual pressure vessel nickel-hydrogen cells have been conceived which should improve the cycle life at deep depths-of-discharge and improve thermal management. Features of the designs which are new and not incorporated in either of the contemporary cells (Air Force/Hughes, Comsat) are: (1) use of alternate methods of oxygen recombination, (2) use of serrated edge separators to facilitate movement of gas within the cell while still maintaining required physical contact with the wall wick, and (3) use of an expandable stack to accommodate some of the nickel electrode expansion. The designs also consider electrolyte volume requirements over the life of the cells, and are fully compatible with the Air Force/Hughes design. Author

N87-16446# Arizona State Univ., Tempe. Solar Energy Lab.
OPEN-CYCLE ABSORPTION SOLAR COOLING. PART 1: COMBINED HEAT AND MASS TRANSFER ON AN OPEN FLOW LIQUID ABSORBENT SOLAR COLLECTOR/REGENERATOR Final Report
K. S. Novak, B. D. Wood, and D. J. Nelson May 1986 321 p (Contract DE-AC03-84SF-12223)
(DE86-014455; ERC-R-86020A-Pt-1) Avail: NTIS HC A14/MF A01

Previous collector/regenerator models have relied on established heat transfer correlations and the heat and mass transfer analogy to specify heat and mass transfer coefficients. These correlations were derived from relatively simple experiments and do not account for the complexities inherent in the collector/regenerator heat and mass transfer problem. This research was prompted by the need for a more accurate performance model based on experimentally determined combined heat and mass transfer correlations. Experimental data were taken on a prototype (11 x 11 m) collector/regenerator during the summer of 1984 in Tempe, Arizona. The data taken included local solution temperature measurements on the collector but only inlet and exit concentration measurements. A solution energy balance was solved iteratively to determine local concentrations and local heat and mass transfer coefficients. A new collector/regenerator model, based on the derived correlations, accurately predicted actual experimental temperature and concentration data. The model was used to test the effects of various climatic, operational, and collector design variables on evaporation rate. DOE

N87-16447# Arizona State Univ., Tempe. Solar Energy Lab.
OPEN-CYCLE ABSORPTION SOLAR COOLING. PART 2: HEAT AND MASS TRANSFER ANALYSIS FOR GLAZED COLLECTOR/REGENERATION Final Report
D. J. Nelson, B. D. Wood, and R. K. Collier May 1986 261 p Prepared in cooperation with Enerscope, Inc., Glendale, Ariz.

(Contract DE-AC03-84SF-12223)
(DE86-014456; ERC-R-86020B-Pt-2) Avail: NTIS HC A12/MF A01

A two-dimensional analysis of steady laminar natural convection in an open ended parallel plate channel is presented for combined heat and mass transfer. Symmetric and asymmetric boundary conditions of uniform wall temperature and concentration (UWT/C) and uniform heat and mass flux (UH/MF) are considered for both aiding and opposing buoyancy due to mass transfer. The numerical method is then applied to model a glazed collector/regenerator component of an open-cycle solar absorption refrigeration system. The solution is coupled to an energy and mass balance on a thin film absorbent flow along one wall. The results indicate that the influence of glazing height is small if the flow is between the fully developed and single plate limits. The glazed collector/regenerator water evaporation rate is higher relative to the unglazed case because the reduction in convective and radiative heat losses increase the absorbent temperature and vapor pressure sufficiently to overcome the concomitant reduction in the mass transfer coefficient. DOE

N87-16448# Arizona State Univ., Tempe. Solar Energy Lab.
OPEN-CYCLE ABSORPTION SOLAR COOLING. PART 3: EVALUATION OF AIR-CONDITIONING SYSTEMS UTILIZING LIQUID ABSORBENTS REGENERATED BY SOLAR ENERGY Final Report
D. A. Siebe, B. D. Wood, and R. K. Collier May 1986 361 p Prepared in cooperation with Enerscope, Inc., Glendale, Ariz.
(Contract DE-AC03-84SF-12223)
(DE86-014457; ERC-R-86020C-Pt-3) Avail: NTIS HC A16/MF A01

Previous open-cycle absorption modeling studies have been very limited and included only the solar collection part of the system. The purpose of this study was to evaluate the critical parameters necessary in order to have a viable system and to evaluate the potential for use of this type of system in various climatic regions of the United States. Thermodynamic property data were reviewed for several possible working solutions, analyzed to give predictive equations, and compiled into subprograms suited to system simulation work. The exergy concept was used to analyze the sources driving cooling systems. It was shown that an effectiveness based on exergy could be used as a thermodynamic common denominator to compare cooling systems using different driving sources, including those that utilize the evaporation of water to the atmosphere. Modeling of the absorber was used to show how an absorber, working with lithium chloride solution, would have to differ from an absorber, working with the lithium bromide solution used in conventional closed absorption-refrigeration equipment. System simulations were done for five system design concepts. DOE

N87-16449# Arizona State Univ., Tempe. Solar Energy Lab.
PHASE 1 OPEN-CYCLE ABSORPTION SOLAR COOLING. PART 4: EXECUTIVE SUMMARY ANALYSIS AND RESOLUTION OF CRITICAL ISSUES AND RECOMMENDATIONS FOR PHASE 2 Final Report
B. D. Wood Jun. 1986 91 p
(Contract DE-AC03-84SF-12223)
(DE86-014458; ERC-R-86020D-Pt-4) Avail: NTIS HC A05/MF A01

The objective of this project is to advance lower cost solar cooling technology with the feasibility analysis, design and evaluation of proof-of-concept open cycle solar cooling concepts. The work is divided into three phases, with planned completion of each phase before proceeding with the following phase: Phase 1 performance/economic/environmental related analysis and exploratory studies; Phase 2 - design and construction of an experimental system, including evaluative testing; Phase 3 extended system testing during operation and engineering modifications as required. For Phase 1, analysis and resolution of critical issues were completed with the objective of developing design specifications for an improved prototype OCA system. DOE

N87-16450# Argonne National Lab., Ill.
PATHWAYS TOWARD A LOW COST EVACUATED COLLECTOR SYSTEM
J. R. Hull, W. W. Schertz, J. W. Allen, J. J. OGallagher, and R. Winston 1986 5 p Presented at the American Solar Energy Society Annual Meeting and 11th National Passive Solar Conference, Boulder, Colo., 8 Jun. 1986 Prepared in cooperation with Chicago Univ., Ill.
(Contract W-31-109-eng-38)
(DE86-014484; CONF-860655-14) Avail: NTIS HC A02/MF A01

The goal of widespread use of solar thermal collectors will only be achieved when they are proven to be economically superior to competing energy sources. Evacuated tubular collectors appear to have the potential to achieve this goal. An advanced evacuated collector using nonimaging concentration under development at the University of Chicago and Argonne can achieve a 50% seasonal efficiency at heat delivery temperatures in excess of 170°C. The same collector has an optical efficiency so that low temperature performance is also excellent. In this advanced collector design all of the critical components are enclosed in the vacuum, and the collector has an inherently long lifetime. The current cost of evacuated systems is too high, mainly because the volume of production has been too low to realize economies of mass production. It appears that certain design features of evacuated collectors can be changed (e.g., use of heat pipe absorbers) so as to introduce new system design and market strategy options that can reduce the balance of system cost. DOE

N87-16451# Argonne National Lab., Ill. Chemical Technology Div.
ADVANCED LITHIUM-ALUMINUM/IRON DISSULFIDE SECONDARY CELL
T. D. Kaun 1986 7 p Presented at the 32nd NASA/US Army International Power Sources Symposium, Cherry Hill, N. J., 8 Jun. 1986
(Contract W-31-109-eng-38)
(DE86-014498; CONF-860688-5) Avail: NTIS HC A02/MF A01

The use of the dense UP-FeS2 electrode and the lower-melting LiCl-LiBr-KBr electrolyte has eliminated the capacity-loss problem of the Li-Al/FeS2 system; with LiCl-KCl electrolyte, the cell would have lost 30% of its capacity in the first 200 cycles. At the same time, the cell performance has been increased significantly. Based on the improved performance, a 250-Ah monopolar cell is expected to achieve a specific energy of 175 Wh/kg at a 4-h rate and specific power of 200 W/kg at 80% DOD. An advanced bipolar battery design has a projected capability of 200 Wh/kg at a 1-h rate with 600 W/kg at 80% DOD, and a battery specifically designed for continuous high power output is projected to provide greater than 2000 W/kg. These bipolar batteries can be operated nearly isothermally because the unique entropic cooling of the upper-plateau FeS2 discharge reaction cancels I^2R heating. The dense upper-plateau FeS cell with its high performance and durability poses exciting possibilities for demanding battery applications such as electric vehicles, stationary energy storage, and satellites. DOE

N87-16452# Argonne National Lab., Ill. Chemical Technology Div.
FAILURE ANALYSIS OF LITHIUM-ALUMINUM/IRON SULFIDE CELLS
J. E. Battles May 1986 7 p Presented at the International Workshop on High Temperature Molten Salt Batteries, Argonne, Ill., 16 Apr. 1986
(Contract W-31109-eng-38)
(DE86-014574; CONF-8604116-5) Avail: NTIS HC A02/MF A01

Post-test examinations were an integral part of the Li-alloy/FeS battery development program at Argonne National Laboratory. Important functions of post-test examinations were to determine the causes of cell failure and to provide recommendations on cell design and assembly techniques that would eliminate these failure modes. Cell failure was generally indicated by a sharp decline in the coulombic efficiency, which is the manifestation of an electrical short circuit between the positive and negative electrodes.

Combinations of macroscopic and microscopic examinations were utilized to identify the source and cause of the short circuits. A special metallographic glovebox facility with a helium atmosphere was constructed for these examinations. Cell failure analysis was conducted on bicells (less than 100-Ah capacity) from the early cell development program and on multiplate cells (about 200- and 400-Ah capacity) from the Mark IA and Mark II battery development programs. Results of the cell failure analysis for the bicell (approx.163 cells) and for the Mark IA multiplate cells are briefly summarized here. DOE

N87-16453# Department of Energy, Washington, D. C. Office of Energy Storage and Distribution.
ELECTROCHEMICAL ENERGY STORAGE PROGRAM Annual Progress Report, 1 Oct. 1984 - 30 Sep. 1985
Jan. 1986 45 p
(DE86-014953; DOE/CE-0121/1) Avail: NTIS HC A03/MF A01

Research on the following topics is summarized: metal/air batteries, ambient temperature lithium batteries, sodium/sulfur batteries, lithium/iron sulfide batteries, fuel cells, hydrogen/nickel oxide batteries, flow batteries. DOE

N87-16454# Massachusetts Inst. of Tech., Cambridge.
PHOTOCHEMICAL ENERGY STORAGE: STUDIES OF INORGANIC PHOTOASSISTANCE AGENTS Progress Report, 1 Oct. 1985 - 30 Sep. 1986
M. S. Wrighton 1986 9 p
(Contract DE-AC02-76ER-04178)
(DE87-000237; DOE/ER-04178/10) Avail: NTIS HC A02/MF A01

Research progress during the period October 1, 1985 to September 30, 1986 has been mainly in the areas of (1) synthesis and characterization of multi-component, macromolecular redox reagents, (2) specific interaction of redox reagents with semiconductor photoelectrode surfaces, including modification procedures for InP, and (3) new photoelectrode modification procedures. These three research areas are ones which will lead to new kinds of interfacial systems for the conversion of visible light to electricity or high energy chemicals in the form of redox products. Several publications have appeared, as listed below, describing some of the highlights of research during the report period. The sections included highlight areas where more recent progress has been made. DOE

N87-16455# Stirling Power Systems Corp., Ann Arbor, Mich.
PHASE 1-B DEVELOPMENT OF KINEMATIC STIRLING/RANKINE COMMERCIAL GAS-FIRED HEAT PUMP SYSTEM Final Report, Sep. 1983 - Dec. 1985
R. E. Monahan Jul. 1986 192 p
(Contract GRI-5083-242-0845)
(PB87-114104; GRI-86/0192) Avail: NTIS HC A09/MF A01 CSCL 10B

The Kinematic Stirling/Rankine gas heat pump concept is based on the application of a Stirling engine that has been under development for over a decade. The engine has been converted to natural gas and is characterized with many thousand hours of operating experience. The goal of the project is to develop a commercial size Stirling engine-driven gas heat pump with a cooling capacity of 10 tons and a COP (heating) of 1.8 and COP (cooling) of 1.1. The project is a multiphase development with commercialization planned for 1989. In this phase, an HVAC systems manufacturer (Borg-Warner) is working with SPS to develop a prototype gas heat pump system. To date, a piston type open shaft refrigeration compressor has been selected as the best match for the engine. Both the engine and compressor have been tested and characterized by performance maps, and the experimental heat pump systems designed, built and preliminary testing performed. Close agreement with computer model output has been achieved. SPS has continued to focus on improving the Stirling engine performance and reliability for the gas heat pump application. GRA

N87-16456*# Clemson Univ., S.C. Center for Semiconductor Device Reliability Research.
INVESTIGATION OF ACCELERATED STRESS FACTORS AND FAILURE/DEGRADATION MECHANISMS IN TERRESTRIAL SOLAR CELLS Final Report
J. W. Lathrop Sep. 1986 89 p
(Contract NAS-7-100)
(NASA-CR-180115; NAS 1.26:180115; DOE/JPL-954929/86/13; DE86-016095) Avail: NTIS HC A05/MF A01 CSCL 10A

This is the final report of a reliability research program to study the response of amorphous silicon colar cells to accelerated temperature testing. The goal of the research was to utilize accelerated testing to identify failure/degradation modes and to relate them to basic physical, chemical, and metallurgical phenomena. Four types of single junction commercial modules were subjected to 140 C testing, both in the dark and under illuminated conditions. The before and after electrical characteristics of individual cells were measured and compared and correlated with physical evidence. A fifth module type could not be tested because of poor adherence of the films to the glass superstrate. A short term effect of stressing was noted which dramatically improved cells with low Voc on one type of construction. All cells eventually showed long term irreversible degradation, but the time to 50% Pm reduction varied by as much as two orders of magnitude depending on construction. No basic difference could be detected between degradation under illuminated or non-illuminated conditions, when cells were either open or short circuited. Comparison with one type of tendem cell and with published results of Japanese cell testing indicated the marked superiority of the tandem cell to all other types. Cells were examined physically by optical, IR, and scanning electron microscopy and by Auger spectroscopy, spectroscopy, secondary ion mass spectroscopy, and energy dispersive x-ray analysis. The long term degradation was felt to be due to localized penetration of aluminum through the amorphous film. DOE

N87-16764*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
INVERSION LAYER MOS SOLAR CELLS
Fat Duen Ho *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N87-16457# Naval Submarine Medical Research Lab., Groton, Conn.
EFFECTS OF ATMOSPHERIC CONTAMINANTS UNDER HYPERBARIC CONDITIONS WITH PARTICULAR REFERENCE TO VISION Interim Report
S. M. Luria 13 Aug. 1986 18 p
(AD-A171838; NSMRL-MR-86-5) Avail: NTIS HC A02/MF A01 CSCL 06/6

A literature search has been carried out for studies investigating the effects, particularly on vision, of atmospheric contaminants under pressure. Little is known of the effects on vision of most contaminants under any pressure. What is known of the effects of oxygen, nitrogen, carbon dioxide and monoxide, ozone, organic vapors, trace metals, and a refrigerant are presented. GRA

N87-16458# Arkansas Univ., Fayetteville. Dept. of Chemical Engineering.
DEVELOPMENT OF VAPOR DISPERSION MODELS FOR NONNEUTRALLY BUOYANT GAS MIXTURES--ANALYSIS OF USAF/N2O4 TEST DATA Final Report, 1 Feb. - 31 Jul. 1985
Thomas O. Spicer and Jerry A. Havens Sep. 1986 103 p
(Contract DTCG23-80-C-2029)
(AD-A172056; AFESC/ESL-TR-86-24) Avail: NTIS

HC A06/MF A01 CSCL 04/1

The Air Force is taking steps to improve and update safety procedures available for use during operations involving hazardous chemicals and fuels. In support of this effort, the Lawrence Livermore National Lab. conducted two field scale releases(Eagle 3 and 6) of nitrogen tetroxide (N2O4) at the Nevada Test Site during 1983. An analysis of the chemical interaction of N2O4 with the ambient humidity and oxygen is made. The reported source mass evolution rate is adjusted to account for these reactions; the source rate for Eagle 3 is between 2.9 and 3.1 kg/s, while for Eagle 6, the source between 1.6 and 1.7 kg/s. Reported nitrogen dioxide (NO2) concentrations downwind of the source are adjusted for the source mass evolution rate, and these observed conditions are compared with predicted concentrations using the Ocean Breeze/Dry Gulch model, the Pasquill-Hanna Gaussian plume model, and DEGADIS. Developed for the Coast Guard, DEGAIS describes the negative buoyancy-driven flows and reduced vertical mixing observed for releases of heavier-than-air gases in the atmosphere. Observed Gaussian equivalent concentration profiles (sigmay and sigmaz) are also compared to predicted values. For these tests, the DEGAIS predictions are consistent with the observed concentration and values sigma y and sigma z, while the Gaussian plume models are not consistent. Furthermore, the importance of negative buoyancy-driven flows and decreased vertical mixing rates for Eagle 3 and 6 is predicted by a characteristic release Richardson number. GRA

N87-16459# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

A THEORY FOR THE SCALAR ROUGHNESS AND THE SCALAR TRANSFER COEFFICIENTS OVER SNOW AND SEA ICE

Edgar L. Andreas Sep. 1986 29 p

(AD-A174089; CRREL-86-9) Avail: NTIS HC A03/MF A01 CSCL 04/1

The bulk aerodynamic transfer coefficients for sensible (C sub H) and latent (C sub E) heat over snow and sea ice surfaces are necessary for accurately modeling the surface energy budget but are very difficult to measure. This report therefore presents a theory that predicts C sub H and C sub E as functions of the wind speed and a surface roughness parameter. The crux of the model is establishing the interfacial sublayer profiles of the scalars, temperature and water vapor, over aerodynamically smooth and rough surfaces. These interfacial sublayer profiles are delivered from surface-renewal model in which turbulent eddies continually sweep down to the surface, transfer scalar contaminants across the interface by molecular diffusion, and then burst away. Matching the interfacial sublayer profiles with the usual semilogarithmic inertial sublayer profiles yields the roughness lengths for temperature and water vapor. With these and a model for the drag coefficient over snow and sea ice based on actual measurements, the transfer coefficients are predicted. C sub E is always a few percent larger than C and H. Both decrease monotonically with increasing wind speed for speeds above 1 m/s, both increase at all winds speeds as the surface gets rougher. Both, nevertheless, are almost between 0.0010 and 0.0015. GRA

N87-16460# Oak Ridge National Lab., Tenn. Div. of Environmental Sciences.

REGION OF INFLUENCE: A METHODOLOGY TEST AT VANDENBERG AIR FORCE BASE

J. R. Krummel, C. T. Hunsaker, A. H. Voelker, and F. C. Kornegay Aug. 1986 78 p

(Contract DE-AC05-84OR-21400)

(DE86-015970; ORNL/TM-9938) Avail: NTIS HC A05/MF A01

This report documents a test of a region of influence (ROI) methodology and a biophysical base-line data base (BDB) which supports the data requirements of the methodology. Environmental issues at Vandenberg Air Force Base (VAFB) provided practical scenarios for demonstrating the ROI methodology. Using this methodology, the investigator determined the geographic extent of air-quality changes due to space shuttle launches, water-quality changes at discharge points on VAFB, and potential water-supply sources to meet future water needs at VAFB. The geographic distribution of both physical (e.g., topography) and biological (e.g., vegetation) attributes on VAFB and the surrounding region is maintained in the BDB. The BDB utilizes a computerized Geographic Information System (GIS) to provide the necessary automated bookkeeping of the spatial data about the attributes and a computerized data-base management system to provide statistical analyses of thematic data. The ROI methodology uses conventional modeling techniques to determine the geographic extent of a disturbance. Regulatory standards and criteria and/or the potential for biophysical effects define the boundary condition of an ROI. Defining an ROI for a proposed action includes three major steps: (1) careful definition of the types of disturbances that may be caused by the action; (2) determination of an appropriate boundary condition (e.g., regulatory criteria); and (3) mapping the ROI boundary, using transport and fate models or physical attributes (e.g., aquifer boundaries) that constrain the transport of the disturbance. DOE

N87-16461# National Center for Atmospheric Research, Boulder, Colo.

DEVELOPMENT OF AN ATMOSPHERIC AEROSOL MODEL FOR STUDIES OF GLOBAL BUDGETS AND EFFECTS OF AIRBORNE PARTICULATE MATERIAL

F. Giorgi 1986 247 p Prepared in cooperation with Georgia Inst. of Tech., Atlanta

(Grant NSF ATM-82-17015)

(PB87-104006; NCAR/CT-102) Avail: NTIS HC A11/MF A01 CSCL 13B

A microphysics-removal atmospheric aerosol model (AAM) is developed for use in general circulation models (GCMs) to study global budgets and effects of particulate material. In this model the particle population is composed of a set of log-normal modes whose time evolution due to microphysical processes is described via prognostic equations for an appropriate number of moments of the particle size distribution. Detailed parameterizations of particle coagulation, sedimentation, dry deposition, and wet removal are developed and implemented into the AAM. The AAM is incorporated into a GCM and is applied to two types of studies: (1) characteristics of the particle wet and dry removal processes, and (2) climatic impact of massive particulate injections following a global nuclear war, with emphasis on the sensitivity of the simulated effects to the inclusion of particle microphysics. Results are discussed. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N87-16462 Cornell Univ., Ithaca, N.Y.

ROCKET STUDIES OF PLASMA TURBULENCE IN THE EQUATORIAL AND AURORAL ELECTROJETS Ph.D. Thesis

Robert Frederick Pfaff, Jr. 1986 609 p

Avail: Univ. Microfilms Order No. DA8607255

Rocket observations of plasma turbulence in the equatorial and auroral electrojets have been studied in detail. Intense electric field and plasma density fluctuations characterize the collisional two-stream and gradient drift instabilities, showing a marked spectral differentiation with respect to height consistent with changes in the local sources of free energy. The interpretation of the frequencies and amplitudes of irregularities detected by in-situ probes traveling at comparable speeds to the waves is discussed in detail. Observations from three rockets in the daytime equatorial electrojet during strong, mild, and weak currents show that the linear theory accounts for the general height and wavelength domains of the irregularities. In the strong case, laminar two-stream waves were observed where the current was strongest and the density gradient was stable. The data suggest phase velocities that were comparable to the electron drift velocity (approx.

5000 m/s) and peak wavelengths (2 to 3 m) that agree with kinetic theory. Vertically propagating waves observed here may have been generated by mode coupling. Where the gradient was unstable, large amplitude, kilometer scale waves dominated, although the linear gradient drift growth rate peaks at a few hundred meters. The equatorial and auroral electrojet observations are compared and together provide a vivid picture of the fields and waves characteristic of plasma instabilities in the earth's ionosphere.
Dissert. Abstr.

N87-16463*# Alabama Univ., Huntsville. Dept. of Physics.
PLASMASPHERE AND MAGNETOSPHERE STRUCTURE FROM ISEE-1 AND DE-1 Progress Report
R. C. Olsen 30 Jan. 1987 8 p
(Grant NAG5-568)
(NASA-CR-180111; NAS 1.26:180111) Avail: NTIS HC A02/MF A01 CSCL 04A

The density structure of the plasmapause was investigated using the two satellites ISEE-1 and DE-2 to obtain complementary radial and latitudinal profiles. Data from the plasma wave receivers were to be used to obtain the total electron density, and from the ion mass spectrometers to determine thermal plasma morphology. Electron density profiles were obtained for 25 sets of orbits when the satellites were adjacent. Author

N87-16464*# Colorado Univ., Boulder. Dept. of Physics.
COMPARISON OF RELATIVISTIC EFFECTS IN BARYCENTRIC AND EARTH-CENTERED COORDINATES AND IMPLICATIONS FOR DETERMINATION OF GM FOR EARTH
Neil Ashby Jan. 1987 24 p
(Grant NAG5-497)
(NASA-CR-180121; NAS 1.26:180121) Avail: NTIS HC A02/MF A01 CSCL 08E

The results of an investigation of relativistic effects which have an influence on the determination of GM sub E (M sub E is the mass of the Earth, G is the Newtonian gravitaional constant) are summarized. The detailed arguments and derivations are discussed. The Parametrized Post-Newtonian (PPN) coordinates; Eddington-Clark (EC) coordinates; a coordinate system based on barycentric dynamical time (TBC coordinates); and Local Inertial coordinates are discussed. Author

N87-16465*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
TERRESTRIAL GRAVITY DATA ANALYSIS FOR INTERIM GRAVITY MODEL IMPROVEMENT Status Report, 30 Jun. - 31 Dec. 1986
Jan. 1987 4 p
(Grant NAG5-781)
(NASA-CR-180123; NAS 1.26:180123; SR-1) Avail: NTIS HC A02/MF A01 CSCL 08E

This is the first status report for the Interim Gravity Model research effort that was started on June 30, 1986. The basic theme of this study is to develop appropriate models and adjustment procedures for estimating potential coefficients from terrestrial gravity data. The plan is to use the latest gravity data sets to produce coefficient estimates as well as to provide normal equations to NASA for use in the TOPEX/POSEIDON gravity field modeling program. Author

N87-16466*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
DEVELOPMENT OF IMPROVED GRAVITY FIELD ESTIMATES USING EXISTING ALTIMETER DATA Status Report, 1 Nov. 1985 - 31 Dec. 1986
Feb. 1987 4 p
(Grant NAG5-519)
(NASA-CR-180122; NAS 1.26:180122; SR-2) Avail: NTIS HC A02/MF A01 CSCL 08G

The formulation of a Fourier series and geographic representation expressions for orbit error were reported. Addition activities include the study of undulation errors in the Lagrangian formulation, and the development and testing of all the necessary software for the above expression. Additionally, the matrix formulations that led to the formation of observed equations and covariance propagation were developed. B.G.

N87-16467# Science Applications, Inc., McLean, Va.
GEOPHYSICAL PLASMAS AND ATMOSPHERIC MODELING Final Report
Ellis Hyman, James Drake, Gurudas Ganguli, Supriya Ganguli, and Charles Goodrich Jul. 1986 722 p
(Contract N00014-85-C-2018)
(AD-A171688; SAIC-86/1781) Avail: NTIS HC A99/MF A02 CSCL 04/1

The major accomplishments of this contract are given. Some of the subjects studied are: Magnetospheric Physics; High Frequency Waves; Whistler Growth in a Cold Plasma Injection Experiment; Collective Particle Accelerator Studies; Magnetosphere-Ionosphere Coupling; High Latitude Ionospheric Investigations; Plasma Transport in the Auroral Return Current Region; Ion Cyclotron Wave Turbulence in the Auroral Ionosphere; Preferred Scale Size in the Structuring of Barium Clouds; Spectral Characteristics of Interchange Turbulence in the Ionosphere; Debris Air Coupling in HANE and in the NRL Laser Experiment; Power Spectral Density of Radiating Plasma Clouds; Debris charge States in HANE and in the NRL Laser Experiment; Lwo Frequency Instabilities in HANE; Numerical Studies of the Dynamics of the Summer Monsoon; Middle Atmosphere Transport and Chemistry Studies. Results are given along with special details in the appendices. GRA

N87-16468# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
EFFECTS OF DIFFERENT CONVECTION MODELS UPON THE HIGH-LATITUDE IONOSPHERE
C. E. Rasmussen, R. W. Schunk, and J. J. Sojka 1986 19 p
(Grant AF-AFOSR-0029-84)
(AD-A171957; AFOSR-86-0670TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

It is well known that convection electric fields have an important effect on the ionosphere at high latitudes and that a quantitative understanding of their effect requires a knowledge of plasma convection over the entire high latitude region. Two empirical models of plasma convection that have been proposed for use in studying the ionosphere are the Volland and Heelis models. Both of these models provide a similar description of two celled ionospheric convection, but they differ in several ways, in particular, in the manner in which plasma flows over the central polar cap and near the polar cap boundary. Ot obtain a better understanding of the way in which these two models affect the ionosphere, two separate runs of our high latitude, time dependent ionospheric model were made, with only the convection models distinguishing the two runs. it was found that the two models were made, with only the convection models distinguishing the two runs. It was found that the two models lead to differences in the ionosphere but often the differences are subtle and are swamped by universal time effects. The most notable differences are in predictions of the height of the F2 peak and in the ion temperature, particularly along the evening polar cap boundary and in the cusp region. For these two parameters, the differences caused by the two different convection models dominate the universal time effects. One question that arises is whether one could examine measurements of plasma density and temperatures and determine which of the two convection models most accurately represents actual ionospheric convection. GRA

N87-16469# Air Force Geophysics Lab., Hanscom AFB, Mass.
PLASMA DENSITIES AND IRREGULARITIES AT 830 km ALTITUDE BASED ON OBSERVATIONS DURING 1979 Interim Report
Frederick J. Rich and Michael Smiddy 28 May 1986 37 p
(AD-A172118; AFGL-TR-86-0121; AFGL-ERP-955) Avail: NTIS HC A03/MF A01 CSCL 04/1

The in situ density of the thermal plasma was observed with instruments on two satellites of the Defense Meteorological Satellite

Program. Each satellite was in a sun synchronous polar orbit so that the two satellites surveyed the topside ionosphere in the mid-morning (7 to 11 hrs magnetic local time) and evening (19 to 23 hrs magnetic local time) sectors. This report presents a survey of the measured thermal ion density in order to determine the median plasma density at 830 km altitude observed as a function of latitude, longitude and season. These results are compared with plasma densities from standard models of the ionosphere, and from previous topside plasma density observations. This report also presents a survey of low and mid latitude regions where plasma density irregularities are found. The plasma density irregularities in the equatorial region are presented as functions of latitude, longitude, and seasons. These regions are probably co-located with regions of Equatorial Spread F radio disturbances. GRA

N87-16470# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
THE ESTIMATION OF THE EARTH'S GRAVITY FIELD
Bela Szabo Jun. 1986 116 p
(Contract F19628-82-K-0017)
(AD-A172177; OSU/DGSS-369; AFGL-TR-86-0125; SR-11) Avail: NTIS HC A06/MF A01 CSCL 08/5

The various methods for the description of the Earth's gravity field from direct and/or indirect observations are reviewed. Geopotential models produced by various organizations and in use during the past 15 years are discussed in detail. Recent and future programs for the improvement of global gravity fields are reviewed and the expected improvements from new observation and data processing techniques are estimated. The regional and local gravity field is also reviewed. The various data types and their spectral properties, the sensitivities of the different gravimetric quantities to datatypes are discussed. The techniques for the estimation of gravimetric quantities and the achievable accuracies are presented (e.g., integral formulae, collocation). The results of recent works in this area by prominent authors are reviewed. The prediction of gravity outside the earth from surface data is discussed in two forms: a) prediction of gravity disturbance at high altitudes and b) upward continuation of gravity anomalies. The achievable improvements of the high frequency field by airborne gradiometry are summarized utilizing recent investigations. GRA

N87-16471# SRI International Corp., Menlo Park, Calif.
HIGH-LATITUDE IONOSPHERIC IRREGULARITIES Final Report, 1 Mar. 1983 - 30 May 1986
James F. Vickrey Jul. 1986 9 p
(Contract F49620-83-K-0025)
(AD-A172474; AFOSR-86-0853TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

A brief summary of some of key results involving the production, transport, and ultimate decay of naturally occurring ionospheric plasma structure is given. GRA

N87-16472# Colorado State Univ., Fort Collins.
MESOSCALE SEVERE WEATHER DEVELOPMENT UNDER OROGRAPHIC INFLUENCES Final Report, 1 May 1985 - 30 Apr. 1986
Elmar R. Reiter, James F. Bresch, Marjorie A. Klitch, Bruce C. MacDonald, and John D. Sheaffer Jul. 1986 15 p
(Contract F49620-85-C-0077)
(AD-A172607; AFOSR-86-0880TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

Overall goals of this 3-year study are to: 1)examine the role of topography in the development of convective systems and 2) assess the orographic influences on cold season severe weather, such as blizzards, lee cyclogenesis, etc. Four approaches were taken to attain these goals: 1)Implementation of a field measurement program, 2) diagnostic studies of energy fluxes during various seasons, 3) numerical simulation of severe weather development, and 4) evaluation of model sensitivity ot various physical processes. Progress has been made on all four of these fronts in the first year. GRA

N87-16473# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY ON FEATURES OF FLOW FIELD AND ATMOSPHERIC DISPERSION PARAMETERS IN MOUNTAINOUS AREA BY BALANCED BALLOONS
Jiang Weimei, Zhou Chaofu, Pan Yunxian, Li Zongkai, and Zhu Zengwang 10 Sep. 1986 19 p Transl. into ENGLISH from Huanjing Kenxue Xuebao (China), v. 6, no. 2, Jun. 1985 p 212-218
(AD-A172820; FTD-ID(RS)T-0694-86) Avail: NTIS HC A02/MF A01 CSCL 04/1

Study results of flow field features and atmospheric diffusion parameters are described. The analysis shows that there are some obvious and significant flow patterns in mountainous area, such as valley breeze, channel wind, fumigation and thermal effect of industrial sources etc. The parameters in three dimensions have been obtained by probing on site. In this paper, some of the problems associated with the calculation of parameters by the method of sliding average using limited number of data are discussed. By using mathematical simulation, the relationship between sampling time and time interval of the sliding average has been analyzed. GRA

N87-16474# Naval Research Lab., Washington, D. C.
PARALLEL CURRENT EFFECTS ON AURORAL E-REGION PLASMA INSTABILITIES Interim Report
P. K. Chaturvedi, J. D. Huba, S. L. Ossakow, and P. Satyanarayana 19 Sep. 1986 34 p
(AD-A172906; NRL-MR-5847) Avail: NTIS HC A03/MF A01 CSCL 04/1

Consider the effect of a field aligned current on the development of plasma instabilities in the auroral electrojet. It is found that the inclusion of the parallel current modifies the threshold criteria for the onset of the Farley Buneman instability, and may cause excitation of oblique ion sound waves. Apply these results to the auroral E region and show that they explain some observations of auroral irregularities, for example, the presence of type I irregularities for sub-threshold conditions (when the electron Hall drift is less than the ion-sound speed), and the observation of irregularities which are not highly field aligned. GRA

N87-16475# Arcon Corp., Waltham, Mass.
DEVELOPMENT OF MODELS FOR INFRARED EMISSION IN THE UPPER ATMOSPHERE Final Report, 5 Jan. 1984 - 4 Jan. 1985
Peter P. Wintersteiner and Robert A. Joseph 1 May 1986 97 p
(Contract F19628-84-C-0071)
(AD-A173633; AFGL-TR-86-0163) Avail: NTIS HC A05/MF A01 CSCL 04/1

The efforts summarized in this final report all relate to modelling infrared emission from non-LTE regions of the upper atmosphere. Included are (1) the results of the study of emission from solar pumped CO2 in the 2.7 region and a description of the methods used to calculate the solar pumping rates and the vibrational temperatures; (2) improvements made in the non-LTE radiance code, NLTE, including the new Voigt profile algorithm; and (3) improvements made in the AFGL Atmospheric Auroral Radiance Code (AARC). GRA

N87-16476# Naval Surface Weapons Center, Dahlgren, Va.
EARTH TIDE ALGORITHMS FOR THE OMNIS COMPUTER PROGRAM SYSTEM Final Report
Walter J. Groeger Apr. 1986 31 p
(AD-A174130; NSWC/TR-86-53) Avail: NTIS HC A03/MF A01 CSCL 08/5

Five computer algorithms are presented which jointly specify the gravitational action by which the tidal redistributions of the Earth's masses perturb satellite motion. Covered are the perturbing effects of the lunar and solar atmospheric tide bulges as well as those of the ocean tides and the solid Earth tide. The lunar air tide algorithm is restricted to the dominant, semidiurnal tide component. The atmospheric tide routine associated with the Sun combines the effects of solar heating and solar mass attraction. It

includes the semidiurnal and diurnal terms. The model for the ocean tide contains the semidiurnal lunar term and 10 additional tide constituents. It also features the effect on the solid Earth tide of the hydrostatic loading by the ocean tide. The algorithm for the solid Earth tide is based on an abbreviated form of the Wahr model outlined in the final version of the MERIT Standards Document. It includes a variety of spectral modes associated with the long-periodic and the semidiurnal tides. The fifth computer routine is a simplified version of the fourth and is provided for use during computer program verification. All computer algorithms express the tidal modifications of the perturbing acceleration experienced by the satellite in terms of corrections to the expansion coefficients of the Earth's gravitational potential. Time enters the model by means of closed-form expressions for the astronomical fundamental arguments adapted from the MERIT Standards nutational model. GRA

N87-16477# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Analysis and Prediction Div.
DESCRIPTION OF COUPLED GENERAL CIRCULATION MODELS OF THE ATMOSPHERE AND OCEANS USED FOR CARBON DIOXIDE STUDIES
W. M. Washington and L. VerPlank Aug. 1986 36 p
(Grant NSF ATM-82-17015)
(PB87-103982; NCAR/TN-271+EDD) Avail: NTIS HC A03/MF A01 CSCL 04A

Described are three coupled atmosphere/ocean models being used at NCAR for studies of climate sensitivity to increased CO2 concentrations. The atmospheric model was adapted from the original version of the NCAR Community Climate Model which was based on the Australian spectral model. The model has been modified by adding a substantially revised radiation/cloudiness scheme and then run with perpetual January and July simulations. To make the model suitable for CO2 studies, it was modified to include an optional seasonal cycle, with predictions of soil moisture, snow cover, and sea ice. Also, three different types of ocean models were made optional features. GRA

N87-16478# Global Geochemistry Corp., Canoga Park, Calif.
ANALYSIS OF GASES IN THE EARTH'S CRUST Annual Report, Mar. 1985 - Feb. 1986
P. D. Jenden May 1986 222 p
(Contract GRI-5081-360-0533)
(PB87-116257; GRI-86/0125) Avail: NTIS HC A10/MF A01 CSCL 08G

To investigate the origin and fate of natural gas in the Earth's crust, approximately 700 gas samples have been analyzed for chemical composition and stable isotopic ratios of carbon, hydrogen, nitrogen, sulfur and oxygen. During the current reporting period, helium isotope measurements confirmed the presence of mantle volatiles in the Sacramento basin, a dry gas province in northern California. Methane carbon isotope ratios and N2/Ar ratios suggest that Sacramento basin commercial gases with up to 88% nitrogen are derived from metasedimentary rocks. Studies of seep gases in Los Angeles indicate that ethane and higher hydrocarbons may be retarded during natural gas migration and the propane is selectively attacked during bacterial alteration. Carbon dioxide reduction and acetate dissimilation, the two main pathways for microbial methane formation, are characterized by different methane hydrogen isotope ratios. Hydrogen isotope ratios of methane and carbon isotope ratios of carbon dioxide and ethane help to distinguish microbial gases, thermogenic gases, and mixed gases. GRA

N87-16676 Centre National d'Etudes Spatiales, Toulouse (France).
A MAGNETIC FIELD MODEL OF THE EARTH'S MAGNETOSPHERE
J. Cl. Kosik *In its* Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 81-88 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16681 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
POLAR WIND AND PLANETARY ORIGIN ION ESCAPES AT HIGH LATITUDES
H. Reme *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 149-183 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16690 Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
CONVERSION OF MAGNETIC ENERGY VIA COLLISIONLESS TEARING MODES: APPLICABILITY OF EXISTING THEORIES TO OBSERVATIONS IN THE EARTH'S MAGNETOTAIL
A. Nishida, T. Terasawa, and M. Hoshino *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 277-295 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16692 Finnish Meteorological Inst., Helsinki. Dept. of Geophysics.
IONOSPHERIC SIGNATURES OF LARGE-SCALE INSTABILITIES IN THE MAGNETOTAIL
Risto J. Pellinen *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 307-314 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16700 Sussex Univ., Brighton (England).
VELOCITY RESONANT WAVE-PARTICLE INTERACTIONS
M. P. Gough, P. J. Christiansen, and A. J. Norris *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 395-402 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16702 Chile Univ., Santiago. Dept. de Fisica.
ULTRALOW FREQUENCY (ULF) ION CYCLOTRON WAVES IN THE MAGNETOSPHERE
L. Gomberoff *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 411-414 (For primary document see N87-16670 08-88)
(Grant E-1742-8533)
Avail: CEPADUES-Editions, Toulouse, France

N87-16714 Centre National de la Recherche Scientifique, Orleans (France).
CORRELATIONS BETWEEN WIDEBAND FREQUENCY WAVES AND ELECTRON/ION FLUXES IN THE EARTH MAGNETOSPHERE
C. Beghin, J. M. Bosqued, J. L. Rauch, F. Lefeuvre, and M. Parrot *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 593-611 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16751*# Miami Univ., Fla. Div. of Meteorology and Physical Oceanography.
A SIMPLE MODEL FOR THE INTERACTION OF PLANETARY AND SYNOPTIC-SCALE WAVES IN THE TROPOSPHERE
Lee E. Branscome *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 04A

N87-16758*# Texas A&M Univ., College Station. Dept. of meteorology.
NUMERICAL MODELING OF WATER-VAPOR TRANSPORT DURING PRE-STORM AND COHMEX
Dusan Djuric *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer FAculty Fellowship Program

Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 04A

N87-16770*# Mississippi State Univ., State College. Dept. of Physics and Astronomy.
IN SEARCH OF STRATOSPHERIC BROMINE OXIDE
John Patrick Lestrade *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 04A

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N87-16479 ESDU International Ltd., London (England).
INTEGRAL LENGTH SCALES OF TURBULENCE OVER FLAT TERRAIN WITH ROUGHNESS CHANGES
Dec. 1986 22 p
(ESDU-86035; ISBN-0-85679-587-9; ISSN-0143-2702) Avail: ESDU

ESDU 86035 provides complementary data on integral length scales of turbulence to those presented in ESDU 85020 and 86010. The latter contain comprehensive information on the properties of turbulence in the atmospheric boundary layer for strong winds (neutral atmosphere). They include a complete description of length scales of turbulence for each component (u, v, w) of fluctuating wind speed in the along-wind, lateral and vertical directions. Length scales are important parameters in the estimation of peak loading and response of ground-based structures and aircraft flying near the ground. The data in the earlier reports related principally to terrain that is uniform for at least 50 km upwind of a site. This is rarely achieved in practice and terrain roughness changes often occur near to a site. This effect is very important. For example, the effect of an upwind roughness change from open country to a site 1 km into a build-up area is to reduce length scales by about 30% below 30m, and by about 50% at larger heights, over values estimated assuming uniform built-up terrain. ESDU

N87-16480# European Space Agency, Paris (France).
SECOND GENERATION METEOSAT DEFINITION STUDIES ON MICROWAVE AND INFRARED VERTICAL SOUNDERS
T. D. Guyenne, ed. Noordwijk, The Netherlands Sep. 1986 103 p
(ESA-STR-219; ETN-87-98833) Avail: NTIS HC A06/MF A01; ESA, Paris, France FF 100 ($15) Member States, AU, CN, and NO (+20% others)

The impact of a microwave radiometer on atmospheric sounding from a Meteosat satellite; and the infrared component of the Meteosat Infrared and Microwave sounder are discussed. For individual titles, see N87-16481 through N87-16482.

N87-16481# Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
DEFINITION STUDY AND IMPACT ANALYSIS OF A MICROWAVE RADIOMETER ON A GEOSTATIONARY SPACECRAFT c19
A. Chedin, D. Pick (Meteorological Office, Bracknell (England).), and R. Rizzi (Bologna Univ. (Italy).) *In* ESA Second Generation Meteosat Definition Studies on Microwave and Infrared Vertical Sounders Sep. 1986 p 5-45 (For primary document see N87-16480 08-47)
Avail: NTIS HC A06/MF A01; ESA, Paris, France FF 100 ($15) Member States, AU, CN, and NO (+20% others)

User's needs for soundings from geostationary altitude are reviewed, and the impact of microwaves in remote sensing is discussed on the basis of observations from the TIROS-N satellites. A Meteosat Microwave Sounder (MMS) is proposed. The initialization and the validation of high horizontal or/and very short range numerical weather prediction models may be considerably improved by the availability of a coupled infrared and microwave passive sounding system on board a geostationary satellite. Due to a much smaller sensitivity to the presence of clouds, the microwave component of this system can produce reliable retrieved temperature or moisture profiles over areas covered by clouds when it is not the case with the infrared component, resulting in a large increase in coverage over areas of great meteorological significance. The MMS comprising 10 channels centered around 118 GHz (6 channels), at 150 GHz, (1 channel) and at 183 GHz (3 channels) coupled with a more classical infrared sounder meets user's requirements. ESA

N87-16482# Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
DEFINITION STUDY OF THE INFRARED COMPONENT OF THE METEOSAT INFRARED AND MICROWAVE SOUNDER
A. Chedin, D. Pick (Meteorological Office, Bracknell (England).), R. Rizzi (Bologna Univ. (Italy).), and P. Schluessel (Kiel Univ. (West Germany).) *In* ESA Second Generation Meteosat Definition Studies on Microwave and Infrared Sounders Sep. 1986 p 47-103 (For primary document see N87-16480 08-47)
Avail: NTIS HC A06/MF A01; ESA, Paris, France FF 100 ($15) Member States, AU, CN, and NO (+20% others)

Infrared sounder options to provide all-weather coverage, particularly of Europe, when coupled with a microwave radiometer on a Meteosat satellite are outlined. The 15, 11-12, 6-7, 4-3, and 40-37 micron channels are proposed. The simplest option, with 12 channels, takes full advantage of the microwave component; the second version, with 4 more channels, meets user's needs, within the clear or partially cloudy areas only, even in case of a failure of the microwave component; the third version, with 19 channels, adds refinements in the surface temperature and water-vapor profile determinations. With a 16 km pixel size, a reasonably compact radiometer should be achievable for a three-axis stabilized system as well as for a spinner. An 8 km version has size problems for both spacecraft types. ESA

N87-16483# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A GLOBAL SOLAR IRRADIANCE CLIMATOLOGY OF AN INTERMOUNTAIN REGION M.S. Thesis
Eugene W. Dobry, Jr. 1986 98 p
(AD-A171907; AFIT/CI/NR-86-156T) Avail: NTIS HC A05/MF A01 CSCL 04/2

A global solar irradiance climatology of an intermountain region is developed using radiation data from ten measurement stations that form the Utah Solar Network. Statistics of daily insolation are prepared based on data collected from 1981-1984. Monthly and weekly periods of daily radiation are found to display a variably skewed frequency distribution. The median statistic is considered more realistic than the mean for determining the average value of these time periods. Daily averages are presented on monthly maps showing the temporal solar energy distribution in Utah. Nonhomogenous terrain significantly distorts the normal latitudinal distribution pattern of irradiance. Effects on weather by the Great Salt Lake and Wasatch Mountain Range are discussed. GRA

N87-16484# National Academy of Sciences - National Research Council, Washington, D. C.
PARTIAL SUPPORT OF BOARD ON ATMOSPHERIC SCIENCES AND CLIMATE Final Report, 1 Dec. 1984 - 30 Nov. 1985
John S. Perry 18 Apr. 1986 8 p
(Grant AF-AFOSR-0062-84)
(AD-A172090; AFOSR-86-0708TR) Avail: NTIS HC A02/MF A01 CSCL 04/2

The scientific and technical objectives of the Board were: (1) Review in broad perspective both basic and applied research dealing with the atmosphere and the solar terrestrial system, and with the physical systems influencing weather and climate. (2) Provide advice and guidance to appropriate government agencies on problems and programs within the Board's interest and expertise, including as examples: Objectives, priorities, plans, and implementation strategies for the National Climate Program; U.S. participation in international research and application pro-

grams relating to the atmosphere and climate such as the Global Atmospheric Research Program and the World Climate Program; and Scientific objectives, priorities, and plans for focused national programs in critical areas of atmospheric science and climate research such as atmospheric chemistry, mesoscale research, weather modification, human impacts on climate, aeronomy, and solar terrestrial research. (3) Foster the application of scientific knowledge of the atmosphere, climate, and social/economic systems to make wise use of atmospheric and climatic resources for the benefit of our country and other nations. GRA

N87-16485# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE CALCULATION AND ANALYSIS OF THE VERTICAL DISTRIBUTION OF TURBULENT PARAMETERS IN THE NEUTRAL PBL (PLANETARY BOUNDARY LAYER)

Miao Manqian and Wang Yanchang 23 Sep. 1986 16 p Transl. into ENGLISH from Daqi Kexue (Xuebao) (China), v. 9, no. 3, Sep. 1985 p 300-307

(AD-A172822; FTD-ID(RS)T-0690-86) Avail: NTIS HC A02/MF A01 CSCL 04/2

By referencing the Lettan Method, the vertical distribution of turbulent parameters-momentum transfer coefficient k sub m, friction velocity u sub *, turbulent shear stress tau and mixing length l were calculated from the observed data of average wind profiles in the neutral planetary boundary layer. The results were compared with research results from abroad and they were basically in fair agreement. Some of the parameters should be modified. GRA

N87-16486# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

ANALYSES OF THE CYCLES DATA SET IN EXTRATROPICAL CYCLONES AND COMPARISONS WITH NUMERICAL MODELS Final Report, 1 Apr. 1981 - 30 Sep. 1985

Peter V. Hobbs 15 May 1986 9 p

(Grant AF-AFOSR-0046-84)

(AD-A173733; AFOSR-86-0914TR) Avail: NTIS HC A02/MF A01 CSCL 04/2

The CYCLonic Extratropical Storms (CYCLES) Field Project was designed to provide measurements and observations on the mesoscale organization of precipitation, and precipitation producing mechanisms, in extratropical cyclones. A series of field studies, employing radars, aircraft, rawinsondes and ground measurements, were carried out off the coast of Washington State during the period 1973-1982. During the period covered by this contract (1981-1985) emphasis has been on analysis and interpretation of the CYCLES field data. Precipitation was found to be organized on the mesoscale into seven different types of rainbands, located in different regions of the cyclone. The air motions, cloud structure and precipitation-producing mechanisms have been documented in each of these rainbands. Numerical models for exploring cloud and precipitation physics and chemistry have been developed for several of the rainbands. Dynamical mechanisms responsible for the formation and maintenance of the rainbands have also been explored. GRA

N87-16487# Naval Oceanographic Office, Bay St. Louis, Miss.

US NAVY CLIMATIC STUDY OF THE CARIBBEAN SEA AND GULF OF MEXICO. VOLUME 3: FLORIDA COASTAL WATERS AND SOUTHWEST ATLANTIC

Jul. 1986 434 p

(AD-A173949; NAVAIR-50-1C-545) Avail: NTIS HC A19/MF A01 CSCL 04/2

This climate study consists of monthly charts and tables of: (1) clouds, (2) precipitation, (3) visibility-tables, (4) ceiling-visibility (mid range/low range), (5) wind-visibility-cloudiness, (6) scalar mean wind speed, (7) wind speed less then 11 and greater or equal to 34 knots, (8) wind speed 11-21 and 22-23 knots, (9) surface wind roses, (10) air and sea temperature, (11) wave height-isopleths, (12) wave height-tables, and (13) surface currents (seasonal). GRA

N87-16488# Air Force Environmental Technical Applications Center, Scott AFB, Ill.

CLIMATIC ATLAS OF ICING POTENTIAL OVER NORTH AMERICA Summary Report

Jan. 1986 129 p

(AD-A174260; USAFETAC/DS-86/001) Avail: NTIS HC A07/MF A01 CSCL 04/1

A climatic atlas of charts that show percent frequency of occurrence of potential icing conditions over North America is examined. Since icing reports are sparse, an accurate icing climatology is difficult to obtain. A climatology of elements for potential icing conditions, however (such as liquid water content and temperature), can be derived. The Smith-Feddes Liquid Water Content (LWC) computer model uses combined data from the Air Force Global Weather Central Three-Dimensional Nephanalysis Data Base (3DNEPH) and the upper air Analysis Data Set for input. Output consists of percent frequency of occurrence of a liquid water content threshold concentration in a defined layer and temperature range. Output was generated for three concentrations, three layers and for temperatures at or below freezing. This data was then manually converted into 117 monthly and annual maps showing percent frequency of occurrence for potential icing conditions. GRA

N87-16489# Defence Research Establishment Valcartier (Quebec).

MULTISCATTERING LIDAR METHOD FOR DETERMINING OPTICAL PARAMETERS OF AEROSOLS

L. R. Bissonnette Oct. 1986 44 p

(AD-A174491; DREV-4430/86) Avail: NTIS HC A03/MF A01 CSCL 07/4

A new lidar technique is proposed for determining aerosol optical parameters. It consists in recording the lidar returns at three fields of view to measure the differences caused by multiple scatterings. The inversion algorithm uses that information to obtain the aerosol forward-scattering coefficient through simple algebraic formulas. Sample solutions are calculated for simulated lidar signals and compared with the results derived from the standard single-scattering lidar equation. The agreement with the true values is very good and performance is consistently better than, or at least good as, that of the single-scattering method. The proposed technique requires neither a boundary value nor a backscatter-to-extinction relation, which makes such lidar measurements completely self-sufficient for the remote determination of the range-resolved forward- scattering coefficient of atmospheric aerosols. GRA

N87-16490# Naval Postgraduate School, Monterey, Calif.

HEAT AND MOISTURE BUDGETS OF AN EXTRATROPICAL CYCLONE BASED ON NAVY OPERATIONAL REGIONAL ATMOSPHERIC PREDICTION SYSTEM (NORAPS) ANALYSES AND FORECASTS M.S. Thesis

Robert E. Rau, Jr. Jun. 1986 136 p

(AD-A174494) Avail: NTIS HC A07/MF A01 CSCL 04/2

Navy Operational Regional Atmospheric Prediction System (NORAPS) analyses and forecasts with 80 km resolution are used to investigate the rapid development of an extratropical cyclone during 28-29 March 1984 over the southeastern United States. The lateral transport of vorticity strongly contributes to the spin-up of the low-level cortex. Diabatic heating and moistening rates are estimated within 500 km of the storm from quasi-Lagrangian heat and moisture budgets and compared with the same rates internally predicted within the NORAPS model. The diagnosed maximum diabatic heating and moistening from analyses agree within 100 mb in elevation and 6 h in time with the model-predicted values. The model-predicted diabatic heating and moistening rates are 50% to 100% greater than diagnosed budget calculations due to an incorrect specification of the moistening and heating rates in NORAPS. Compared to more intense cases of explosive maritime cyclogenesis, the higher level and lower magnitude of maximum diabatic heating is consistent with the weaker deepening rate and continental nature of this storm. is storm. Author (GRA)

N87-16491# Naval Postgraduate School, Monterey, Calif.
RELATING THE DISTRIBUTIONAL CHARACTER OF NUMERICAL MODEL OUTPUT PARAMETERS TO THE OCCURRENCE OF FOG OVER THE NORTH ATLANTIC OCEAN M.S. Thesis
Oliver J. Muldoon Jun. 1986 58 p
(AD-A174543) Avail: NTIS HC A04/MF A01 CSCL 04/1

An investigation is described of the statistical distributional character of six model output parameters from Fleet Numerical Oceanographic Center's Navy Operational Global Atmospheric Prediction System, as a function of the occurrence of Fog and No Fog for a climatologically homogeneous area of the North Atlantic Ocean in summer. Beta, Normal and Gamma distributions were fitted to these parameters and forecasts of Fog and No Fog were made using Baye's Law. Intercomparisons were made of these forecasts, using various categorical scoring systems (Threat Score, Percentage Correct, False Alarm, Forecast Reliability and Power of Detection), as well as a probabilistic scoring system (Penalty-Reward Score). The forecast results were examined for significant differences using an Anova analysis. Predictor populations whose underlying distributions are of an exponential form are much better represented by a Beta or Gamma distribution than by a Normal. For predictors whose distributions are quasi-bell shaped, the Beta distribution can be generally used as a proxy for the Normal, as can the Gamma. However, in some cases the Normal distribution results in better forecast scores, and the decision on use of a proxy would depend on which of the scores is to be emphasized. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N87-16492*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ARCHIVAL OF SEASAT-A SATELLITE SCATTEROMETER DATA MERGED WITH IN SITU DATA AT SELECTED, ILLUMINATED SITES OVER THE OCEAN
Lyle C. Schroeder and Jon L. Sweet (PRC Kentron, Inc., Hampton, Va.) Feb. 1987 21 p
(NASA-TM-87736; L-16156; NAS 1.15:87736) Avail: NTIS HC A02/MF A01 CSCL 08J

A large data base of Seasat-A Satellite Scatterometer (SASS) measurements merged with high-quality surface-truth wind, wave, and temperature data has been documented. The data base was developed for all times when selected in situ measurement sites were within the SASS footprint. Data were obtained from 42 sites located in the coastal waters of North America, Australia, Western Europe, and Japan and were assembled by correlating the SASS and surface-truth measurements in both time and distance. These data have been archived on a set of nine-track 6250 bpi ASCII coded magnetic tapes, which are available from the National Technical Information Service. Author

N87-16493# Naval Academy, Annapolis, Md.
ANALYSIS OF SURFACE PATTERNS OVER COBB SEAMOUNT USING SYNTHETIC-APERTURE RADAR IMAGERY Final Report, 1985 - 1986
Clark B. Freise 27 May 1986 64 p
(AD-A171670; USNA-TSPR-136) Avail: NTIS HC A04/MF A01 CSCL 17/9

Anomolies in surface wave patterns observed on SEASAT Synthetic-Aperture Radar (SAR) imagery over Cobb Seamount are examined. These anomalies are the surface expression of currents interacting with the seamount. The wavelength of the imaged surface patterns are extracted with advanced SAR digital image processing techniques. Nine of the ten detected wavelengths match the expected spectral wavelength envelope of the internal waves that are calculated using oceanographic data. The results show that the wavelengths of the surface pattern imaged are actually the surface manifestation of internal waves on a subsurface density interface. The internal waves are created by current flow over and around Cobb Seamount disturbing the density interface. Author (GRA)

N87-16494# Woods Hole Oceanographic Institution, Mass.
GIBRALTAR EXPERIMENT: A PLAN FOR DYNAMIC AND KINEMATIC INVESTIGATIONS OF STRAIT MIXING, EXCHANGE AND TURBULENCE
Harry L. Bryden and Thomas Kinder Aug. 1986 87 p
(Contracts N00014-82-C-0019; N00014-85-C-0001)
(AD-A172500; WHOI-86-29) Avail: NTIS HC A05/MF A01 CSCL 08/3

The flow through the Strait of Gibraltar has always held a special fascination for oceanographers. Attempts to understand and measure the strong currents in the Strait stimulated many of the early advances in oceanography (Deacon, 1971). Over the centuries, the focus of scientific investigations has shifted from understanding how the mass budget of the Mediterranean is maintained in the presence of the strong inflow of Atlantic water through the Strait of Gibraltar, to observing the outflow of Mediterranean water over the Gibraltar sill, to measuring the two-layer exchange of Atlantic inflow and Mediterranean outflow through the Strait. In the past few years the focus has again shifted to the study of how the dynamical constraints for flow through a narrow and shallow strait act to control the amount of exchange between the Atlantic and Mediterranean basins. To investigate the dynamics of flow through a strait, a year-long field experiment has been designed to measure the flows through the Strait of Gibraltar, including their time variability over tidal to seasonal time scales, and to assess the importance of friction, mixing, rotation, and nonlinear processes in controlling the exchange through the Strait. This field program called the Gibraltar Experiment will be carried out by a group of American, Spanish, Moroccan, Canadian and French scientists during the period from Fall 1985 to Fall 1986. GRA

N87-16495# National Museum of Natural History, Paris (France). Lab. d'Oceanographie Physique.
NUMERICAL MODEL OF SEA ICE INTERACTION Final Report
Marie N. Houssais Aug. 1986 74 p
(Contract DAJA45-85-M-0383; DA Proj. 1T1-61102-BH-57)
(AD-A173664; R/D-4836-EN-01) Avail: NTIS HC A04/MF A01 CSCL 08/12

A numerical model designed to study the seasonal dynamics of ice-ocean interactions in the Greenland Sea is described. First the thermodynamic aspect of the problem is examined by means of a coupled thermodynamic sea ice-ocean mixed layer model. Secondly, the ocean dynamics is introduced by embedding the vertical zonal oceanic slab across the Greenland Sea. Sea ice and the under-lying ocean are dynamically interactive in this complete version of the coupled model. Results obtained in these two parts of the study are then outlined and, where possible, compared with some climatological data sets. A special attention is paid to the mixed layer deepening/retreat process, in relation with the seasonal evolution of the ice distribution, as an indicator of the deep convection efficiency in a region where winter deep water formation is expected to occur. GRA

N87-16496# Washington Univ., Seattle. Applied Physics Lab.
XCP (EXPENDABLE CURRENT PROFILER) PERFORMANCE NEAR THE GEOMAGNETIC EQUATOR
M. A. Kennelly, P. A. McKeown, and T. B. Sanford Jul. 1986 48 p
(Contract N00014-82-C-0038)
(AD-A174105; APL-UW-8607) Avail: NTIS HC A03/MF A01 CSCL 20/4

Velocity profiles collected with an expendable current profiler (XCP) and with a recoverable free fall profiler, TOPS (Total Ocean Profiling System), are compared in the vicinity of the geographic and geomagnetic equators. The XCP operates on the principles of motional induction, measuring the electric currents that result

from the movement of seawater through the vertical component of the earth's magnetic field. Induced electric currents that results from the movement of seawater through the vertical component of the earth's magnetic field. Induced electric currents are interpreted in terms of the oceanic velocity structure. TOPS is a freely falling profiler that utilizers acoustic tracking techniques to measure velocity structure at the longer vertical wavelengths (lambda is greater than 20 m) and an onboard two axis acoustic velocimeter to measure fine structure (20 m is greater than lambda is greater than 20 cm). Previous mid-latitude intercomparisons showed these two profilers to agree within 1-2 cm/s rms. The present study, conducted in March-April 1982, took place in the eastern equatorial Pacific to compare profiler performance near the magnetic equator (8 deg 10 min S at 95 deg W). Results of measurements made along a transect from 3 deg N to 8 deg S are presented. As the magnetic equator is approached, the performance of the XCP relative to that of TOPS degrades because the vertical component of the geomagnetic field diminishes. The two major sources of error seem to be inadequate compensation for the fall rate and vessel interference. Probe-to-probe variability is attributed to electronic phase differences, which are more noticeable near the magnetic equator. GRA

N87-16497# Science Applications International Corp., McLean, Va.
ACOUSTIC SCATTERING KERNELS FROM ARCTIC SEA ICE Technical Report
David Rubenstein Oct. 1986 70 p
(Contract N00014-84-C-0180)
(AD-A174235; SAIC-86/1077) Avail: NTIS HC A04/MF A01 CSCL 20/1

A new algorithm for computing scattering kernels from Artic ice keels is described. The basic equations are adapted from Burke and Twersky (1966) but the algorithm does not involve approximations in the limits of low or high frequencies, and is therefore more accurate. Calculations over a range of frequencies and grazing angles are presented. An important result is obtained. At high frequencies (greater than 200 hz) a significant component of the incoherent scattered energy is directed into shallow propagation angles (less than 15 degrees). This component must be accounted for in estimates of scattering loss. GRA

N87-16498# Bern Univ. (Switzerland). Inst. fuer Physik.
Ar-39 MEASUREMENTS ON SAMPLES EXTRACTED FROM OCEAN WATER Final Report
H. Oeschger and H. H. Loosli 1986 12 p
(Contract DE-AC02-81ER-60009)
(DE86-015458; DOE/ER-60009/T1) Avail: NTIS HC A02/MF A01

The penetration into the ocean of disturbance at the atmosphere-ocean interface is studied by the analysis of transient tracers like bomb-produced C-14, H-2 and anthropogenic Kr-85 and freons, and of radioactive isotopes produced by cosmic radiation in the atmosphere, like pre-nuclear C-14 and Ar-39. This paper discusses the use of Ar-39 and gives examples of measurements of Ar-39 taken in the Atlantic and Pacific Oceans. DOE

N87-16499# North Carolina State Univ., Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
DYNAMIC VARIABILITY OF THE GULF STREAM FRONT IN THE CAROLINA CAPES
L. C. Sun, L. J. Pietrafesa, and G. S. Janowitz 1986 43 p
(Contract DE-FG09-85ER-60376)
(DE86-015492; DOE/ER-60376/T3) Avail: NTIS HC A03/MF A01

A theoretical investigation of the stability of a two-layer Gulf Stream model by a numerical technique is presented. This study is based on the hypothesis that the dynamic variability of the time-dependent baroclinic jet, which is assumed to be in geostrophic equilibrium to the lowest order, may be due to subinertial frequency disturbances propagating along the coast and acting as a time-dependent perturbation to the geostrophic jet. Our present model investigates the combined baroclinic-barotropic instability problem. The numerical results show that the baroclinic process transfers kinetic energy from the mean flow to the perturbation, while the barotropic process transfers kinetic energy from the perturbation to the mean flow. The former is more dominant than the latter, so the baroclinic process destabilizes the system, and a net transfer of kinetic energy is formed from the mean flow to the perturbation. The numerical results also show a release of potential energy from the mean flow to the perturbation, providing the energy necessary for the existence of a baroclinically unstable disturbance. The observational formation of the sinuous meander or folded-back filament on the Gulf Stream front is theoretically explained by the presence of southward/northward traveling disturbances with phase speeds less than the mean northward speed of the Gulf Stream, so that the manifestation of sense of propagation of the frontal feature is to the north. DOE

N87-16500# JAYCOR, Vienna, Va.
GULF OF MEXICO CIRCULATION MODELING STUDY, YEAR 2 Annual Progress Report, 1986
A. J. Wallcraft Apr. 1986 100 p Sponsored by Minerals Management Service
(Contract DI-14-12-0001-30073)
(PB87-107421; MMS/GOM-86/0027) Avail: NTIS HC A05/MF A01 CSCL 08C

The report gives details of the second year of a four-year numerical ocean circulation modeling program for the Gulf of Mexico. The purpose is to progressively upgrade in modest increments an existing numerical ocean circulation model of the Gulf so that the final model will have a horizontal resolution of about 10 km and vertical resolution approaching 1 to 10 m in the mixer layer, 10 m at the thermocline and 100 m in the deep water. Throughtout the four-year period, the validity of the upgraded model will be continuously tested, and velocity field time series delivered periodically based on the most realistic simulation of Gulf circulation available. Wind-forced only, port-forced only, and wind plus port-forced simulations were generated. Details of selected experiments are presented in the report. GRA

N87-16501# National Meteorological Center, Washington, D.C.
COMPENDIUM OF MARINE METEOROLOGICAL AND OCEANOGRAPHIC PRODUCTS OF THE OCEAN PRODUCTS CENTER
D. M. Feit Sep. 1986 105 p Prepared in cooperation with Ocean Products Center, Washington, D.C.
(PB87-101812; NOAA-TM-NWS-NMC-68; CONTRIB-5) Avail: NTIS HC A06/MF A01 CSCL 08C

The Compendium provides a brief description of the operational and experimental marine meteorological and oceanographic products of the Ocean Products Center (OPC). Included is information on (1) marine meteorology, (2) ocean thermal structure, (3) ocean waves and (4) polar seas and Great Lakes ice. GRA

N87-16502# National Ocean Service, Rockville, Md.
SAN FRANCISCO BAY AREA CIRCULATION SURVEY: 1979-1980
J. M. Welch, J. W. Gartner, and S. K. Gill Nov. 1985 190 p
(PB87-107181; NOS-OCEANOGRAPHIC SURVEY-7) Avail: NTIS HC A09/MF A01 CSCL 08J

An oceanographic survey was conducted during 1979 and 1980, and represents the most comprehensive physical investigation of the San Francisco Bay estuarine system to date. Extensive measurements were made of water currents, tides, temperature, and salinity, and various meteorological parameters, including wind speed, direction, atmospheric pressure, and temperature. Deep-sea tide, current-to-wave signal-to-noise, and additional water quality parameters were acquired in addition to the standard circulation survey data. Survey results are presented in the form of tables, figures, and relevant discriptive information about the measurements. GRA

51 LIFE SCIENCES (GENERAL)

N87-16503*# Management and Technical Services Co., Washington, D.C.
USSR SPACE LIFE SCIENES DIGEST, INDEX TO ISSUES 5-9
Lydia Razran Hooke Washington NASA Jan. 1987 112 p
(Contract NASw-3676)
(NASA-CR-3922(11); NAS 1.26:3922(11)) Avail: NTIS HC A06/MF A01 CSCL 06B

An index to issues 5 through 9 of the USSR Space Life Sciences Digest is provided in two sections. The first section lists bibliographic citations of abstracts contained in the Digest issues covered, grouped by topic area categories. Cross references to other relevant abstracts in different categories are also provided. The second section provides a key word index for the same set of abstracts. Author

N87-16504*# National Aeronautics and Space Administration, Washington, D.C.
LIFE SCIENCES SPACE STATION PLANNING DOCUMENT: A REFERENCE PAYLOAD FOR THE EXOBIOLOGY RESEARCH FACILITIES
Feb. 1987 62 p
(NASA-TM-89606; NAS 1.15:89606) Avail: NTIS HC A04/MF A01 CSCL 06B

The Cosmic Dust Collection and Gas Grain Simulation Facilities represent collaborative efforts between the Life Sciences and Solar System Exploration Divisions designed to strengthen a natural exobiology/Planetary Sciences connection. The Cosmic Dust Collection Facility is a Planetary Science facility, with Exobiology a primary user. Conversely, the Gas Grain Facility is an exobiology facility, with Planetary Science a primary user. Requirements for the construction and operation of the two facilities, contained herein, were developed through joint workshops between the two disciplines, as were representative experiments comprising the reference payloads. In the case of the Gas Grain Simulation Facility, the astrophysics Division is an additional potential user, having participated in the workshop to select experiments and define requirements. Author

N87-16505# SRI International Corp., Menlo Park, Calif. Life Sciences Div.
NEUROPHYSIOLOGICAL BASES OF EVENT-RELATED POTENTIALS Annual Report, 1 May 1985 - 30 Apr. 1986
Charles S. Rebert 8 Aug. 1986 66 p
(Contract F49620-82-K-0016)
(AD-A172995; AFOSR-86-0910TR; AR-4) Avail: NTIS HC A04/MF A01 CSCL 06/3

In order to more fully understand the physiological and psychological significance of event-related brain potentials, cortical and subcortical recordings were obtained from monkeys performing an operant conditioning task (cued reaction time). During the past year three cynomolgus monkeys were studied following the administration of MPTP, a drug that selectively destroys nigra-striatal dopaminergic neurons in the pars compacta of the substantia nigra. This manipulation indicated the critical role of the nigra-striatal dopamine for task performance enhancement would be to determine if increasing nigra-striatal dopaminergic activity would enhance performance and electrophysiological responsivity. GRA

N87-16506# Desmatics, Inc., State College, Pa.
STATISTICAL IMPACT ACCELERATION INJURY PREDICTION MODELS BASED ON -G SUB X ACCELERATOR DATA
Carl A. Mauro, Kevin C. Burns, and Dennis E. Smith Oct. 1986 48 p
(Contract N00014-85-C-0846)
(AD-A173720; TR-126-1) Avail: NTIS HC A03/MF A01 CSCL 06/17

Since 1974, the Naval Biodynamics Laboratory (NBDL) has collected, as part of its research effort on acceleration impact injury prevention, an extensive data base from -G sub x accelerator runs on Rhesus subjects. Over this time period, Desmatics, Inc. has been actively involved in the development of statistically based models to predict injury in Rhesus subjects resulting from indirect head/neck impact acceleration in the -X direction. The objectives of the present technical report are: (1) to summarize, update, and consolidate the Desmatics modeling efforts for fatal injury; (2) to investigate extending the injury prediction models to include nonfatal injury criteria; and (3) to evaluate the accuracy and validity of the prediction models obtained in the modeling efforts. GRA

N87-16507# Veterans Administration Hospital, Loma Linda, Calif.
TISSUE INTERACTIONS WITH NONIONIZING ELECTROMAGNETIC FIELDS Final Report, Mar. 1979 - Feb. 1986
W. R. Adey, S. M. Bawin, C. V. Byus, C. D. Cain, S. Lin-Liu, R. A. Luben, D. B. Lyle, P. M. Sagan, A. R. Sheppard, and M. A. Stell Aug. 1986 21 p Prepared in cooperation with Loma Linda Univ., Calif. and California Univ., Riverside
(Contract DE-AI01-79ET-29078)
(DE86-014715; DOE/ET-29078/T2) Avail: NTIS HC A02/MF A01

This report provides an overview of this research program focused on basic research in nervous system responses to electric fields at 60 Hz. The emphasis in this project was to determine the fundamental mechanisms underlying some phenomena of electric field interactions in neural systems. The five studies of the initial program were tests of behavioral responses in the rat based upon the hypothesis that electric field detection might follow psychophysical rules known from prior research with light, sound and other stimuli; tests of electrophysiological responses to normal forms of stimulation in rat brain tissue exposed in vitro to electric fields, based on the hypothesis that the excitability of brain tissue might be affected by fields in the extracellular environment; tests of electrophysiological responses of spontaneously active pacemaker neurons of the Aplysia abdominal ganglion, based on the hypothesis that electric field interactions at the cell membrane might affect the balance among the several membrane-related processes that govern pacemaker activity; studies of mechanisms of low frequency electromagnetic field interactions with bone cells in the context of field therapy of united fractures; and manipulation of cell surface receptor proteins in studies of their mobility during EM field exposure. DOE

N87-16508# Arizona Univ., Tucson. Dept. of Biochemistry.
MECHANISMS OF ENERGY CONVERSION BY CHLOROPHYLL Technical Progress Report, 1 Mar. 1983 - 1 Jan. 1986
G. Tollin 1986 7 p
(Contract DE-AC02-78ER-04927)
(DE87-000753; DOE/ER-04927/17) Avail: NTIS HC A02/MF A01

Studies to elucidate the detailed mechanisms of light-induced one-electron transfer reactions involving chlorophyll and electron donors and acceptors in lipid bilayer vesicles are reported. The interactions between the elementary steps in these processes and parameters such as bilayer viscosity, surface electrical charge, and donor and acceptor structure are described. A body of fundamental information which can be used to devise strategies for increasing the yields of the high energy products of such reactions, to physically separate these products so as to decrease the probability of reverse electron transfer (i.e., back reaction), and to facilitate secondary electron transfer to external donors and acceptors were sought. Such information should prove useful in the development of biomimetic systems for practical solar energy conversion based on green plant photosynthesis. DOE

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N87-16509* National Aeronautics and Space Administration, Washington, D.C.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 292)
Jan. 1987 70 p
(NASA-SP-7011(292); NAS 1.21:7011(292)) Avail: NTIS HC A04 CSCL 06E

This bibliography lists 192 reports, articles and other documents introduced into the NASA scientific and technical information system in December, 1986. Author

N87-16510*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE POTENTIAL IMPACT OF THE NEWLY PROPOSED QUALITY FACTORS ON SPACE RADIATION PROTECTION
John W. Wilson, Lawrence W. Townsend, and Francis A. Cucinotta (Old Dominion Univ., Norfolk, Va.) Jan. 1987 17 p
(NASA-TM-89055; NAS 1.15:89055) Avail: NTIS HC A02/MF A01 CSCL 06R

The recently proposed changes in the defined quality factor hold great potential for easing some of the protection requirements from electrons and protons in the near-Earth environment. At the same time, the high Linear Energy Transfer (LET) components play an even more important role which must be further evaluated. Several recommendations are made which need to be addressed before these new quality factors can be implemented into space radiation potection practice. Author

N87-16511# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
VEHICULAR SIMULATOR-INDUCED SICKNESS. VOLUME 2: A SELECTED ANNOTATED BIBLIOGRAPHY Final Report, Aug. 1985 - Aug. 1986
John G. Casali and J. R. Roesch 31 Aug. 1986 47 p
(Contract N00014-84-K-0226)
(AD-A172990; IEOR-TR-8502; NTSC-TR-86-011) Avail: NTIS HC A03/MF A01 CSCL 06/19

A serious problem associated with training and research applications of both driving and flight simulators is the provocation of illness symptoms and after effects in human subjects. In spite of its frequency and severity, human factors research attention to the problem of simualtor sickness has been somewhat scant. However, documentation of a number of instances of simulator-induced sickness appears in journal articles, technical reports, and memoranda. Several other publications have specifically addressed the syptomatology and/or the etiology of the problem, while a few papers have described laboratory or field studies. This report includes bibliographic listings and abstracts for those references which have direct mention of simulator sickness and does not attempt to represent the plethora of associated articles on motion sickness and human perception. The majority of the bibliography is comprised of incidence reports, field surveys, technical memoranda on specific simulators, reports on countermeasures, and research studies on simulator design aspects, procedural and operational aspects, and subject individual differences such as experience level and perceptual style. It is intended to provide the researcher or simulator user with an up-to-date source of background representing the state of knowledge on simulator sickness. GRA

N87-16512# Indiana Univ., Indianapolis. Research and Sponsored Programs.
SLEEP DEPRIVATION AND EXERCISE TOLERANCE Final Report, 1 Feb. 1981 - 31 Jan. 1986
Bruce J. Martin Jan. 1986 11 p
(Contracts DAMD17-81-C-1023; DA Proj. 3E1-62777-A-879)
(AD-A172931) Avail: NTIS HC A02/MF A01 CSCL 06/19

Acute sleep deprivation radically alters mood and sleepiness. It blunts, as well, the ability to perform long-term maximal exercise. These effects are more evident after 50 than after 25 hours without sleep. Sleeplessness does not, however, change any measured physiological responses to exercise. Stress hormone levels, that is beta-endorphin and cortisol, are the same during exercise with or without prior sleep. Similarly, exercise heart rate, ventilation, and blood pressure, and blood lactate levels, are identical under the two conditions. We conclude that sleep loss hampers physical performance primarily through psychological mechanisms. GRA

N87-16513# Oak Ridge National Lab., Tenn.
RADIATION CARCINOGENESIS FOLLOWING LOW DOSE OR LOW DOSE RATE EXPOSURES
R. L. Ullrich 1986 11 p Presented at the Radiological Accidents, Perspectives and Emergency Planning Preparedness, Bethesda, Md., 15 Sep. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000350; CONF-860932-6) Avail: NTIS HC A02/MF A01

A variety of dose responses have been observed for cancer induction following low linear energy transfer (LET) radiation. In general, however, the response is curvilinear, with a rapidly rising component in the intermediate dose range followed by a plateau or decline in incidence at high doses. The response is more linear at low doses, whereas the response at intermediate doses is approximated by a dose-squared relationship. Models for this response are based on the biophysical theory of cellular effects. However, many types of effects contribute to the tumorigenic processes, and host factors play a major role. At low dose rates the carcinogenic effect is generally reduced, which is caused by a dimunition of the dose-squared component and results in a linear response. Effects of fractionation can vary with total dose, fraction size, and fraction interval. High LET radiation is more tumorigenic. The dose-response relationships are more nearly linear and are less dose-rate dependent. The relative biological effectiveness (RBE) varies with dose, dose rate, fractionation, and target tissue. DOE

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N87-16514# New York Univ., New York.
THE PERCEPTION OF THE HIGHER DERIVATIVES OF VISUAL MOTION Interim Report, 31 Dec. - 31 Dec. 1983
Lloyd Kaufman and Samuel J. Williamson 24 Jun. 1986 27 p
(Grant AF-AFOSR-0050-82)
(AD-A171855; AFOSR-86-0514TR; IR-1) Avail: NTIS HC A03/MF A01 CSCL 05/10

This report describes theoretical work involved in the early stages of this research effort and gives a brief review of the literature studied during that work. In particular, it reviews work on velocity difference thresholds, since several workers have concluded that judgmental comparisons of velocities at different times accounts for the human ability to discriminate between uniform linear motion in the frontal plane and acceleration. This conclusion is consistent with physiology, where motion detecting units are found to be sensitive to speed in specific directions, and none are known to be tuned to respond to particular rates of change of speed. No models of motion perception include provisions for detecting either changes in speed or changes in direction. Direct work on acceleration, however, is flawed. Hence, we devised a novel stimulus composed of sine wave gratings that drift at an average speed across the display. The speed is sinusoidally modulated, thus introducing acceleration and jerk (the third dervative). We also control spatial frequency, drift rate and luminance contrast. An experiment is described along with a computer program to permit conduct of the experiment. GRA

N87-16515# Essex Corp., Orlando, Fla.
ISSUES IN PERFORMANCE MEASUREMENT FOR MILITARY AVIATION WITH APPLICATIONS TO AIR COMBAT MANEUVERING Final Report, 15 Apr. 1985 - 4 Apr. 1986
Norman E. Lane 4 Apr. 1986 157 p

(Contracts DAAG29-81-D-0100; AF Proj. 4796)
(AD-A172986; EOTR-86-3; NTSC-TR-86-008) Avail: NTIS HC A08/MF A01 CSCL 05/9

This report describes the history, development and current practice of measuring operator performance in systems, in particular military aviation systems, with additional emphasis on measurement in air combat maneuvering (ACM). The principal themes are that: (1) performance is used interchangeably with proficiency, and as such has acquired evaluative meanings about goodness or badness of individual capabilities. Performance measures thus require the same attention to measurement properties and validation as any other measures on individuals; (2) there are tendencies to substitute physical measures, which scale physical quantities or events, for behavioral measures, which are representative of how well an individual can perform a given task. Performance measures are behavioral measures, and acquire meaning through validation operations beyond those required for physical measurement. Not all the measures obtainable on individuals or systems are appropriately called performance measures; (3) task performance must be viewed as a construct. Tasks are complex and multidimensional; individual proficiency must be inferred from limited observables. For proposed measures, it is necessary to show that measures are reliable, that they tap the most important components of successful performance, and that they are credible as representatives of individual task proficiency. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation*.

N87-16516 California Univ., Berkeley.
SYSTEM MODELING AND VIBRATION ANALYSIS OF BAND/WHEEL MECHANICAL SYSTEMS Ph.D. Thesis
Kon-Well Wang 1985 150 p
Avail: Univ. Microfilms Order No. DA8610263

High speed axially moving bands, driven by rotating wheels, are the basic elements in many machines. In this research, a model describing the coupled motions is formulated and verified. Hamilton's Principle is used to derive the equations of motion and boundary conditions. The resulting equations are linearized and then discretized by applying the Galerkin Method. The results show that the mechanism of vibration coupling is the finite equilibrium curvature of the band. The transverse vibrations of the spans are linearly coupled to their longitudinal motions and to the motion of the wheels. The contributions of various system parameters to the coupling are clarified. The effects of different types of linear damping on the band/wheel system dynamics are analyzed. The damping in each mode is examined by calculating the real part of the corresponding eigen-value. Once the dominating modes are identified, one can minimize the principal span vibration by adjusting the damping distribution of the system. Dissert. Abstr.

N87-16517# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ROBOTIC MANIPULATOR CONTROL PERFORMANCE EVALUATION Ph.D. Thesis
Michael R. Leahy, Jr. Aug. 1986 218 p
(AD-A172919; AFIT/CI/NR-86-173D) Avail: NTIS HC A10/MF A01 CSCL 13/9

A robotic manipulator dynamically based controller performance baseline is established by the creation and utilization of a hierarchical robotic evaluation environment. Creation of a hierarchical robotic evaluation environment provides an original solution to the problems that previously constrained real-time evaluation of modern manipulator control schemes. Utilization of that environment fulfills the application of proposed theories. The performance baseline is established by simulated and experimental evaluation of feedforward dynamics and feedback loop design for joint motion high speed trajectory tracking robot control. The real-time performance produced by application of all proposed robotic control techniques to harmonic and gear driven manipulators can be extrapolated from the baseline. A feedforward loop composed of uncoupled inertia and gravity dynamics exhibited the best tracking accuracy. Forces unmodeled by those dynamics can be effectively treated as disturbances to the feedback loop. Dynamic based control techniques exhibited the potential to control high speed gross motion of a manipulator without additional sensor devices. GRA

N87-16518# Drexel Univ., Philadelphia, Pa. Biomedical Engineering & Science Inst.
A PULSATING ANTI-GRAVITY SUIT FOR ACCELERATION PROTECTION: SYSTEM DESCRIPTION AND PRELIMINARY EXPERIMENTS Interim Report
T. W. Moore, B. R. Reddy, J. Foley, F. Kepics, and L. Hrebien Jul. 1986 7 p
(Contract N00014-85-K-0566)
(AD-A173708; NADC-86120-60) Avail: NTIS HC A02/MF A01 CSCL 06/11

This document describes a system designed to study the feasibility of augmenting tolerance to acceleration stress using external pressure pulsations synchronized to the electrocardiogram. The system, known as synchronized pulsating anti-gravity suit, consists of a modified G Suit, a controller and a pneumatic subsystem. The modified suit has individual bladders for calf, thigh, and abdomen with separate inlet/outlet ports. A microcomputer controls the synchronization, phasing and sequencing of pressure pulses in the bladders. Desired high and low pressures are obtained using feedback of pressure signals to a set of comparators. Solenoid valves and related circuitry regulate the flow of air in and out of the bladders. Results based on the centrifuge experiments suggest the feasibility of obtaining improved tolerance with a synchronized pulsating suit. GRA

N87-16519# New Mexico State Univ., Las Cruces. Behavioral Engineering Lab.
HUMAN FACTORS AFFECTING PILOT PERFORMANCE IN VERTICAL AND TRANSLATIONAL INSTRUMENT FLIGHT Final Technical Report
Stanley N. Roscoe 1986 31 p
(Contract N00014-81-K-0439)
(AD-A174057; BEL-86-1/ONR-86-1) Avail: NTIS HC A03/MF A01 CSCL 05/5

A program to apply the best aircraft control and display ideas and principles generated since World War II to an integrated, computer-based system for vertical and translational instrument flight is reviewed. A generic thrust-borne aircraft capable of vertical takeoff and landing (VTOL) and six degrees of maneuvering freedom was simulated, as were a forward-looking contact analog display and a downward-looking horizontal situation display. Features incorporated in these displays included command guidance symbology, directionally compatible frequency-separated quasi-pursuit flight path predictors with vernier-deviation indications and uniquely integrated presentations of altitude and vertical speed in the horizontal situation display. Features of the simulated control system included automatic stabilization of position and velocity vector against air mass movements and reduced orders of maneuvering performance control. A holistic experimental approach was applied to screen critical dynamic design variables, optimize their response surfaces, and investigate direction of display motion relationships, all leading to multiple-regression models of pilot performance in vertical and translational instrument flight. GRA

N87-16520# Human Engineering Labs., Aberdeen Proving Ground, Md.
THE EFFECT OF HELICOPTER VIBRATION ON THE ACCURACY OF A VOICE RECOGNITION SYSTEM Final Report
Thomas W. Dennison, Frank J. Malkin, and Christopher C. Smyth Sep. 1986 15 p
(AD-A174284; HEL-TM-11-86) Avail: NTIS HC A02/MF A01 CSCL 17/2

Speech recognition technology could be especially advantageous to single-crewmember helicopters like the Light Helicopter Family (LHX). Before speech recognition can be considered a viable technology for helicopters, several issues remain to be resolved. One of these is changes in the voice that occur as a result of stress, noise, and vibration. This paper reports the results of an investigation conducted to determine the effect of vibration-induced changes in the voice on the accuracy of a speech recognition system. A series of flight tests were conducted using 12 participants and 8 different flight maneuvers. Data were collected with the participants speaking 50 phonetically balanced words into the speech recognizer while seated in the copilot's seat of a UH-1H helicopter during each of the 8 flight maneuvers. The results indicate that speech recognition system accuracy is not affected by helicopter vibration. GRA

N87-16521# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
OPTICAL TOLERANCES FOR ALIGNMENT AND IMAGE DIFFERENCES FOR BINOCULAR HELMET-MOUNTED DISPLAYS
Herschel C. Self May 1986 38 p
(AD-A174536; AAMRL-TR-86-019) Avail: NTIS HC A03/MF A01 CSCL 06/19

The literature on optical alignment and image difference tolerances for binocular devices are reviewed. Tolerances for vertical and horizontal misalignment and for rotation, magnification and luminance differences are recommended. Recommendations are made for collimation tolerance and for eye relief and exit pupil diameter for helmet-mounted binocular displays. Formulas are derived for magnification difference tolerances for partially and totally overlapping fields of view. GRA

N87-16331*# California Univ., Santa Barbara.
DUTY CYCLE TESTING AND PERFORMANCE EVALUATION OF THE SM-229 TELEOPERATOR
Robert S. Stoughton and Daniel P. Kuban (Oak Ridge National Lab., Tenn.) *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 133-148 Previously announced as N86-31059 (For primary document see N87-16321 08-39)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A14/MF A01 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N87-16522*# National Aeronautics and Space Administration, Washington, D.C.
PUBLICATIONS OF THE EXOBIOLOGY PROGRAM FOR 1985: A SPECIAL BIBLIOGRAPHY
Jan. 1987 70 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contract NASw-3165)
(NASA-TM-89605; NAS 1.15:89605) Avail: NTIS HC A04/MF A01 CSCL 03B

The Exobiology Program, within the Office of Space Science and Applications of the National Aeronautics and Space Administration, is an integrated program to methodically investigate those processes that are responsible for, or related to, the origin, evolution, and distribution of life in the universe. The list of 1985 publications resulting from research pursued is contained. B.G.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N87-16523# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 18, NO. 2 Monthly Report
Judith Nagle-Eshleman, ed. Feb. 1986 102 p
(AD-A166896) Avail: NTIS HC A06/MF A01 CSCL 20/11

Topics addressed include: microprocessors; dynamic balancing; rail vehicle dynamics; dynamics and control; mechanical and structural systems; components; mechanical properties; and design analysis. For individual titles, see N87-16524 through N87-16524.

N87-16524# Schenck Trebel Corp., Deer Park, N.Y.
DYNAMIC BALANCING WITH MICRO PROCESSORS
D. G. Stadelbauer *In* Shock and Vibration Information Center The Shock and Vibration Digest, Volume 18, No. 2 Feb. 1986 p 3-6 (For primary document see N87-16523 08-60)
Avail: NTIS HC A06/MF A01 CSCL 09/2

The advantages of balancing are discussed using a microprocessor. The balancing procedure is outlined and illustrated. Author

N87-16525# SRI International Corp., Menlo Park, Calif.
REWRITE RULE MACHINE Progress Report
Joseph Goguen, Claude Kirchner, Sany Leinwand, Jose Meseguer, and Timothy Winkler Jul. 1986 16 p
(Contract N00014-85-C-0417)
(AD-A170920) Avail: NTIS HC A02/MF A01 CSCL 09/2

Perhaps the most significant accomplishment of the Rewrite Rule Machine (RRM) project so far has been to explore the hardware and software implications of a novel model of computation, concurrent tree rewriting. This model serves as a bridge between easily programmed Ultra High Level Languages (UHLLs), featuring implicit concurrency, and advanced architectural designs having unprecedented performance (thousands of MIPS). Additional accomplishments include: (1) construction of a (high level) instrumented simulator for a declarative UHLL (called OBJ) running on the RRM; (2) demonstration that OBJ can be used effectively to program the RRM; (3) demonstration that large amounts of concurrency are available in typical OBJ programs; (4) design of even more powerful UHLLs for the RRM that combine object-oriented, functional and logic programming; (5) exploration of more detailed computational models and hardware designs for the RRM; and (6) progress toward a powerful graphical notation for UHLL programming. These results are found to be very encouraging and their fruition in a prototype machine is anticipated.
Author (GRA)

N87-16526# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical and Computer Engineering.
FABRICATION OF MATERIAL AND DEVICES FOR VERY HIGH DENSITY INFORMATION STORAGE Final Report, Jan. - Dec. 1985
Mark H. Kryder, David Thuel, Chris Bowman, and Ching-Hsing Huang 24 Nov. 1986 15 p

(Grant AF-AFOSR-0100-85)
(AD-A174548; AFOSR-86-1082TR; FR-1) Avail: NTIS HC A02/MF A01 CSCL 20/3

An ion beam deposition system was purchased and utilized for research on magnetic materials and devices for high density magnetic information storage. Initial work was carried out on the deposition of permalloy and the deposition of magnetic oxides. The work on permalloy revealed that ion beam deposited materials generally had smaller grain size and lower coercivity than R.F. sputtered materials. It was also found that the grain size and coercivity of ion beam deposited materials increased of a second ion gun were used to bombard the substrate during the deposition process. This work is being continued with support from other sources. The work on magnetic oxides was begun with the deposition of cobalt ferrite. X-ray diffraction measurements indicate the material deposited was amorphous and exhibited a hard axis of anisotropy perpendicular to the plane of the film. This work is also being continued with support from other sources. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

N87-16527# RAND Corp., Santa Monica, Calif.
THE ROSS LANGUAGE MANUAL
David McArthur, Philip Klahr, and Sanjai Narain Sep. 1985 57 p
(Contract F49620-82-C-0018)
(N-1854-1-AF) Avail: NTIS HC A04/MF A01

The commands of the ROSS language, an object-oriented programming language currently being developed at Rand, are summarized. The goal of ROSS is to provide a programming environment in which users can conveniently design, test, and change large knowledge-based simulation of complex mechanisms. Object-oriented programming languages, and ROSS in particular, enforce a message-passing style of programming in which the system to be modeled is represented as a set of actors and their behaviors (rules for actor interaction) This style is especially suited to simulation, since the mechanism of process to be simulated may have a part-whole decomposition that maps naturally onto actors. Furthermore, the real-world interactions between parts may be easily modeled by actor behaviors and actor message-transmissions. The first section gives an overall view of the language and the philosophy behind object-oriented programming. The next eleven sections give detailed descriptions of the basic commands or behaviors of the language. The final two sections give advice on how to write English-like code in ROSS and how to optimize code, once it has been debugged.
Author

N87-16528*# Rensselaer Polytechnic Inst., Troy, N.Y. Center for Interactive Computer Graphics.
OVERVIEW OF DATABASE PROJECTS Semiannual Status Reports
Michael J. Wozny 24 Jan. 1987 203 p Presented at the Industrial Associates Review, 6-7 Nov. 1986
(Grant NAG5-487)
(NASA-CR-180108; NAS 1.26:180108) Avail: NTIS HC A10/MF A01 CSCL 09B

The use of entity and object oriented data modeling techniques for managing Computer Aided Design (CAD) is explored. B.G.

N87-16529*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
TOWARD REAL-TIME PERFORMANCE BENCHMARKS FOR ADA
Russell M. Clapp, Louis Duchesneau, Richard A. Volz, Trevor N. Mudge, and Timothy Schultze Jul. 1986 137 p Sponsored in part by General Dynamics
(Grant NAG2-350)
(NASA-CR-180125; NAS 1.26:180125; RSD-TR-12-86) Avail: NTIS HC A07/MF A01 CSCL 09B

The issue of real-time performance measurements for the Ada programming language through the use of benchmarks is addressed. First, the Ada notion of time is examined and a set of basic measurement techniques are developed. Then a set of Ada language features believed to be important for real-time performance are presented and specific measurement methods discussed. In addition, other important time related features which are not explicitly part of the language but are part of the run-time related features which are not explicitly part of the language but are part of the run-time system are also identified and measurement techniques developed. The measurement techniques are applied to the language and run-time system features and the results are presented.
Author

N87-16530# Maryland Univ., College Park. Center for Automation Research.
SHAPE FROM TEXTURE: GENERAL PRINCIPLE
Ken-Ichi Kanatani and Tsai-Chia Chou Feb. 1986 40 p
(Contract DAAK70-83-K-0018)
(AD-A171613; CAR-TR-184; CS-TR-1618) Avail: NTIS HC A03/MF A01 CSCL 06/4

The 3D shape of a textured surface is recovered from its projected image on the assumption that the texture is homogeneously distributed. First, the homogeneity of a discrete texture consisting of dots and line segments is defined in terms of the theory of distributions. Next, distortion of the observed texture density due to perspective projection is described in terms of the first fundamental form, which is expressed with respect to the image coordinate system. Based on this result, the basic equations to determine the surface shape are derived for both planar and curved surfaces, and numerical schemes are proposed to solve them. Necessary data is obtained in the form of summation or integration of functions over the texture elements on the image plane. Ambiguity in the interpretation of curved surfaces is also analyzed. Finally, numerical examples for synthetic data are presented, and this method is compared with other existing methods. It is shown that all other methods can be explained in terms of this formulation. GRA

N87-16531# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering and Computer Science.
A PARALLEL FIRST-ORDER LINEAR RECURRENCE SOLVER
Gerald G. L. Meyer and Louis J. Podrazik Sep. 1986 29 p
(Grant AF-AFOSR-0097-85)
(AD-A171686; JHU/EECS-86/07) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper presents a parallel algorithm for the solution of first-order linear recurrence systems of size N when the number of processors p is small in relation to N. GRA

N87-16532# Army Construction Engineering Research Lab., Champaign, Ill.
MAT: AN INTERACTIVE CALCULATOR FOR MATRIX OPERATIONS. DESCRIPTION AND APPLICATION EXAMPLES Final Report
Kim M. Bloomquist Aug. 1986 28 p
(AD-A171701; CERL-SR-N-86/16) Avail: NTIS HC A03/MF A01 CSCL 05/3

This report describes the commands, operators, and functions of mat-an interactive interpreter and calculator for solving systems of equations expressed as matrices. Also provided are examples that show how the system is used to solve problems in matrix algebra, input-output analysis, and regression analysis, mat features a full range of matrix and scalar operators and built-in functions for carrying out numeric and nonnumeric matrix transformations. It also provides checks for errors in conformability and other run-time problems. GRA

N87-16533# Naval Postgraduate School, Monterey, Calif.
FOURTH GENERATION PROGRAMMING LANGUAGES M.S. Thesis

Everett L. Jacobson Jun. 1986 75 p
(AD-A171773) Avail: NTIS HC A04/MF A01 CSCL 09/2

With an ever increasing demand for new program applications and the failure of older generations of languages, such as COBOL, PL/I, PASCAL, etc., to keep up with this increased demand, there exists a need for new techniques and approaches to programming. Greater programmer/user productivity and enhanced user friendliness, to allow more end users to develop applications on their own, are goals sought by industry in order to reduce skyrocketing backlogs of applications. This paper describes a new generation of programming languages, used in the development of business and scientific applications, that addresses and achieves these goals. The basic characteristics of Fourth Generation Languages is reviewed and the design and implementation of a Fourth Generation Language is proposed. Although Fourth Generation Languages do increase user productivity and are easier to learn and use than previous generations of languages, much research remains to be done before general end user computing becomes the norm rather than the exception.
Author (GRA)

N87-16534# Stanford Univ., Calif. Dept. of Computer Science.
LEARNING OBJECT-LEVEL AND META-LEVEL KNOWLEDGE IN EXPERT SYSTEMS M.S. Thesis
Li-Min Fi Nov. 1985 230 p
(Contract N00039-83-C-0136)
(AD-A171794; STAN-CS-86-1091) Avail: NTIS HC A11/MF A01 CSCL 09/2

A high performance expert system can be built by exploiting machine learning techniques. A learning model has been designed and implemented that is capable of constructing a knowledge base, in the form of rules, from a case library and continuously updating it to accommodate new facts. This model is designed primarily for EMYCIN-like systems in which there is uncertainty about data as well as about the strength of inference and in which the rules chain together to infer complex hypotheses. These features greatly complicate the learning problem. In machine learning, two issues that cannot be overlooked practically are efficiency and noise. A subprogram, called CONDENSER, is designed to remove irrelevant features during learning and improve the efficiency. The noise can be handled by optimizing the result to achieve minimal prediction errors. Another subprogram has been developed to learn meta-level rules which guide the invocation of object-level rules and thus enhance the performance of the expert system using the object-level rules. Using the ideas developed in this work, an expert program called JAUNDICE has been built, which can diagnose the likely disease and mechanisms of a patient with jaundice. Experiments with JAUNDICE show the developed theory and method of learning are effective in a complex and noisy environment where data may be inconsistent, incomplete, and erroneous.
Author (GRA)

N87-16535# White Sands Missile Range, N.Mex. Inst. Directorate.
SPIN FREQUENCY DETECTION IN THE SPECTRAL DOMAIN Final Report
David S. Jimarez Mar. 1986 140 p
(AD-A171828; STEWS-ID-86-1) Avail: NTIS HC A07/MF A01 CSCL 17/9

This research involves the development, implementation and optimization of algorithms for tracking the spectral spin frequency representations of a revolving cylindrical target having four protruding scatterers. The investigation is limited to coherent phase and amplitude data that are constant to within a few millimeters per second with respect to the base of the cylinder, spin frequencies between five and fifteen Hz, and an absolute spin frequency rate of change less than 1.25 Hz per second. The research was conducted such that the algorithms and procedures that were developed could be performed by analysts who are relatively unskilled in this analysis. The heuristic methodology utilized in this effort is one wherein a working model of the expert analyst's problem-solving approach is obtained by observing him perform the manual procedure, generating the associated protocols, and then programming this intelligence into the machine. The manual procedure was easy to understand and to implement in the machine.
GRA

N87-16536# New York Univ., New York. Inst. of Mathematical Sciences.
PROTEUS PARSER REFERENCE MANUAL
Ralph Grishman Jul. 1986 32 p
(Contracts N00014-85-K-0163; N00014-85-K-2028)
(AD-A171841; PM-4) Avail: NTIS HC A03/MF A01 CSCL 09/2

This manual describes the English language syntactic analyzer developed by the PROTEUS Project at New York University, and the version of Restriction Language which is used to write grammars for this analyzer. This system is a direct descendant of the Linguistic String Parser, developed by the Linguistic String Project at New York University (since 1973 in collaboration with the Computer Science Department). In particular, we have tried to maintain as much commonality as possible in the Restriction Language used for stating grammars. In developing our new implementation, we have had three objectives: 1) use LISP. The current Linguistic String Parser is implemented in FORTRAN. It is therefore quite efficient but is hard to interface to AI applications, which are usually best developed in LISP. The PROTEUS system has been entirely implemented in LISP. 2) remain small and modular. The Linguistic String Parser gradually became so large and complex that further modification was difficult. Through redesign and the elimination of some features, we have sought to return to a simpler, more easily modifiable system. 3) accomodate different analysis algorithms. One aspect of our current research is the study of alternative analysis strategies. We have therefore tried to develop a system which could accomodate different analysis algorithms. In particular, we have designed the grammar formalism to work with both top-down and bottom-up analyzers.
GRA

N87-16537# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A COLOR-GRADIENT PRE- AND POST-PROCESSOR FOR 2-D FINITE ELEMENT STRESS ANALYSIS PROGRAMS Final Report
James M. Bender Jun. 1986 66 p
(AD-A172129; BRL-TR-2736) Avail: NTIS HC A04/MF A01 CSCL 09/2

A pre- and post-processor of finite element data for use on a color graphics microcomputer has recently been developed. The entire data file, which includes information for gridding, material properties and loading schemes, can be generated and debugged locally on a microcomputer before being sent to the mainframe computer. Before the emergence of advanced, large memory microcomputers, the preprocessing was performed interactively with the mainframe computer which consumed a considerable amount of wall-clock time. Another advantage of pre-processing on microcomputers is that the mainframe is less burdened by interactive usage and is returned to the batch mode allowing it to perform more jobs in less time. The post-processor transforms the output data into a representative color, denoting a component, and intensity of that color, denoting a normalized stress level in the element. This allows the analyst to examine the state of stress in a multi-component structure in a single picture. For effective stress the stresses are normalized with respect to the material yield strength in each component. For the three unidirectional and shear stresses the elements comprising each component are searched for the maximum value and stresses are normalized to that value.
Author (GRA)

N87-16538# Washington Univ., St. Louis, Mo. Dept. of Computer Science.
LONG-RANGE TECHNOLOGICAL IMPACT ON COMPUTER-AIDED PRODUCT DEVELOPMENT AT DMA (DEFENSE MAPPING AGENCY) Final Report, Jan. 1983 - Jan. 1986
Gruia-Catalon Roman, R. H. Lykins, Robert K. Israel, H. C. Cunningham, and Michael E. Ehlers Jul. 1986 270 p
(Contract F30602-83-K-0065)
(AD-A173599; RADC-TR-86-49) Avail: NTIS HC A12/MF A01

CSCL 09/2

Increasing demands are being placed on DMA by DOD organizations for Mapping, Charting, and Geodesy products. To meet these demands, DMA must automate labor intensive tasks, particularly with regards to photo interpretation and software development, and maintenance practices must be responsive to changes in DMA needs. Geographic Data Processing(GDP) systems are the key vehicle for automation of the production process. The DMA Modern Programming Environment(MPE) implementation effort offers the means for an evolutionary upgrade for changing software programming needs. Technology advances in areas such as artificial intelligence database modelling, high speed processing, problem oriented languages, Ada, etc. are fertile for exploitation. However, improper application of the technologies could prove to be costly as well as of little value. This study has produced a requirements specification and validation methodology which could significantly reduce the risk associated with building GDP systems through the development of inexpensive rapid prototypes. GRA

N87-16539# Mitre Corp., Bedford, Mass.
ADVANCED ARCHITECTURES FOR SIGNAL PROCESSORS: (A SIMPLE RNS (RESIDUE NUMBER SYSTEM)/SYSTOLIC ARCHITECTURE FOR ISOLATED WORD RECOGNITION) Final Report, Oct. 1984 - Oct. 1985
D. O. Carhoun, W. L. Eastman, and A. L. Bequillard Jul. 1986 169 p
(Contract F19628-84-C-0001)
(AD-A173600; MTR-9727; RADC-TR-86-59) Avail: NTIS HC A08/MF A01 CSCL 09/2

Isolated word recognition is a computationally intensive processing function for which the combination of residue number system (RE4NS) computation and systolic array architecture offers practical simplification in the design of a special-purpose hardware processor. We have developed a simple architecture that uses short-time correlation analysis to form the spectral patterns, a distortion function employing squared Euclidean distance between the normalized correlation values of the test and reference utterance segments, and a two-dimensional pipelined processor array to implement dynamic time-wraping for pattern registration. With the exception of the normalization of the sample correlation values, all significant computations are carried out in a residue number system of compact size to be implemented in a specially designed hardware of low complexity. This combination of techniques provides for a very high processing throughput in simple hardware that can be used for real-time word recognition in a large vocabulry. GRA

N87-16540# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/logistics Dept.
GUIDE TO USING DISPLAY INTEGRATED SOFTWARE SYSTEM AND PLOTTING LANGUAGE (DISSPLA) Final Report
Kevin G. Brady 1 May 1986 67 p
(AD-A173643; DTNSRDC/CMLD-86-18) Avail: NTIS HC A04/MF A01 CSCL 09/2

This document is intended to give the user a basic understanding of Display Integrated Software System and Plotting Language. All examples were taken from implementations at David Taylor Naval Ship R & D Center to show actual scientific uses. All examples were run, unless specifically stated, on the VAXcluster using version 9.2 of DISSPLA. This version will soon be available on the CYBERs and aside from certain machine dependencies, all examples will then run on the CYBERs. In interactive examples, underlined commands are typed by the user. GRA

N87-16541# Stanford Univ., Calif. Knowledge Systems Lab.
THE CAOS SYSTEM
Eric Schoen Mar. 1986 74 p
(Contract F30602-85-C-0012)
(AD-A174178; KSL-86-22; STAN-CS-86-1125) Avail: NTIS HC A04/MF A01 CSCL 09/2

The CAOS system is a framework designed to facilitate the development of highly concurrent real-time signal interpretation applications. It explores the potential of multiprocessor architectures to improve the performance of expert systems in the domain of signal interpretation. CAOS is implemented in LISP on a (simulated) collection of processor-memory sites, linked by a high-speed communications subsystem. The virtual machine on which it depends provides remote evaluation and packet-based message exchange between processes, using virtual circuits known as streams. To this presentation layer, CAOS adds (1) a flexible process scheduler, and (2) an object-centered notion of agents, dynamically-instantiable entities which model interpreted signal features. This report documents the principal ideas, programming model, and implementation of CAOS. A model of real-time signal interpretation, based on replicated abstraction pipelines, is presented. For some applications, this model offers a means by which large numbers of processors may be utilized without introducing synchronization-necessitated software bottlenecks. The report concludes with a description of the performance of a large COAS application over various sizes of multiprocessor configurations. Lessons about problem decomposition grain size, global problem solving control strategy, and appropriate services provided to CAOS by the underlying architecture are discussed.
Author (GRA)

N87-16542# Rockwell International Corp., El Segundo, Calif. North American Aircraft Div.
CADS: A COMPUTER AIDED DESIGN SYSTEM. VOLUME 3: PROGRAM MAINTENANCE MANUAL Final Report, Dec. 1981 - May 1985
Michael C. Less and Susan Manuel Oct. 1986 313 p
(Contract F33615-81-C-3229)
(AD-A174229; AFWAL-TR-85-3066-Vol-3) Avail: NTIS HC A14/MF A01 CSCL 09/2

This is the program maintenance manual for the Computer Aided Design System, CADS. CADS is a pre and post processor for structural analysis and optimization programs based on the finite element method. The system supports five functional modules controlled by an Executive Monitor. All of these modules communicate with a data base through a data manager. In addition a post output translator, CADSPP, is available which processes output from finite element programs, e.g., NASTRAN, directly into the data base. This report gives a detailed description of the internal structure of CADS for use in future maintenance and enhancement of the code. CADS uses two random access files to store the geometry and analysis program results for a finite element model. The geometry (GEOM) data base is used to store all the elements, grid points, and similar model information. The POST data base is used to store analysis results such as element stresses and forces, grid displacements and modal output. Detailed descriptions of the individual data records for the GEOM and POST data bases are given. In addition, each subroutine or function is described. Subroutine descriptions include an outline of its purpose and approach, routine inputs and outputs, error messages, external calls, the argument list, a key variable list and a list of common blocks. A brief discussion on the installation of CADS is also included. Author (GRA)

N87-16543# Texas Univ., Austin. Dept. of Computer Sciences.
UNIFIED APPROACH TO PARALLEL COMPUTATION: PERFORMANCE EVALUATION AND ARCHITECTURALLY INDEPENDENT PARALLEL PROGRAMMING Progress Report, 1 Sep. 1985 - 31 Aug. 1986
J. C. Browne Jun. 1986 8 p
(Contract DE-FG05-85ER-25010)
(DE86-014683; DOE/ER-25010/T1) Avail: NTIS HC A02/MF A01

The report includes a summary of research in the area of parallel programming, a list of publications, and new research directions. Research accomplishments in the areas of formulating a universal model of parallel computation, the design of architecturally independent programs, the design of algorithmically specialized parallel architectures, and the generalized mapping of computations to architectures are presented. DOE

N87-16544# Lawrence Livermore National Lab., Calif. Mechanical Engineering Dept.
TOPAZ2D: A TWO-DIMENSIONAL FINITE ELEMENT CODE FOR HEAT TRANSFER ANALYSIS, ELECTROSTATICS AND MAGNETOSTATICS PROBLEMS
A. B. Shapiro Jul. 1986 109 p
(Contract W-7405-eng-48)
(DE86-014749; UCID-20824) Avail: NTIS HC A06/MF A01

TOPAZ2D is a two-dimensional implicit finite element computer code for heat transfer analysis, electrostatics, and magnetostatics problems. This report provides a user's manual for TOPAZ2D and a description of the numerical algorithms used. Sample problems with analytical solutions are presented. TOPAZ2D has been implemented on the CRAY and VAX computers. DOE

N87-16545# Lawrence Livermore National Lab., Calif.
CONVERTING SCIENTIFIC SOFTWARE TO MULTIPROCESSORS: A CASE STUDY
R. E. Strout, II 20 Jun. 1986 96 p
(Contract W-7405-eng-48)
(DE86-014751; UCRL-53751) Avail: NTIS HC A05/MF A01

This paper examines the process and problems involved in converting an application to make use of these machines. A set of FORTRAN routines forming an ordinary differential equation solving software package is used as the subject of the work. A set of explicit primitives for concurrent programming, the Cray multitasking primitives, is used as the method for exploiting concurrency on a Cray X-MP/48 supercomputer. Data analysis is discussed as a useful technique in the conversion, and the tools available within the supercomputing environment are examined for their usefulness in performing the data analysis. Two conversions are performed on the software package. First, to allow multiple problems to execute concurrently, and second, to exploit parallelism within each individual problem. The problems involved in each of these conversions are presented with their considered solutions. Performance measurements are presented for each conversion performed. The data analysis procedure was found too complex and time consuming to perform without appropriate tools. More work than expected was required to produce the first conversion. Finally, the largest source of problems is the lack of sufficient support for multiprocessing from the FORTRAN language. DOE

N87-16546# Oak Ridge National Lab., Tenn. Div. of Computing and Telecommunications.
PLOT COMMAND: A SUITE OF GRAPHICS POSTPROCESSORS
M. L. Ballou and W. H. Gray Mar. 1986 16 p Presented at the ISSCO Week, New Orleans, La., 10 Mar. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000231; CONF-860363-4) Avail: NTIS HC A02/MF A01

At Martin Marietta Energy Systems, Inc., a wide variety of plotting devices and graphics software is available, but the same set of graphics software and hardware is not consistently available across the different computer systems. However, a suite of computer software known as the PLOT command has been developed to provide a unified approach to graphics postprocessing for two DECsystem-10s, a dual IBM 3033, and numerous VAXs. The PLOT commands accept a graphics metafile or command file and the name of a plotting device and then use this information to decide which postprocessor to execute. For a postprocessor located on a remote computer, the PLOT commands create and transmit the necessary job control statements to process a user's request, and for plotting to a graphics terminal or a locally available plotting device, the PLOT commands directly execute the appropriate postprocessor. Thus, a single integrated command allows users to plot a variety of graphics metafiles or command files on a diversity of plotting devices. DOE

N87-16547# Department of Energy, Washington, D. C.
CREATING TABLES WITH TPL
10 Oct. 1986 66 p
(DE87-000952; DOE/EIA-0500) Avail: NTIS HC A04/MF A01

Table producing Language (TPL) was developed by the Bureau of Labor Statistics (BLS) as a tool to meet their large publishing demands for statistical tables and data analysis. To meet it's own large publishing demands, EIA has incorporated TPL as one of it's methods to produce statistical tables. TPL is a flexible, computer-based system designed to select, format, tabulate, and display data. The user specifies the horizontal (row) and vertical (column) headings, input data, and content of a table, but does not encode the actual logic to create the table. The two basic elements of TPL are the codebook and the table request. The codebook describes the input data to be used in the table production. After a codebook has been created, you are ready to write the TPL request. The TPL request is the statements that together create a set of instructions that produce the table. DOE

N87-16332*# Mechanical Dynamics, Inc., Ann Arbor, Mich.
PSEUDO-PROTOTYPING OF AEROSPACE MECHANICAL DYNAMIC SYSTEMS WITH A GENERALIZED COMPUTER PROGRAM
Vikram N. Sohoni and Milton A. Chace *In* NASA. Lewis Research Center The 20th Aerospace Mechanics Symposium May 1986 p 149-163 (For primary document see N87-16321 08-39)
Avail: NTIS HC A14/MF A01 CSCL 09B

N87-16743*# Furman Univ., Greenville, S.C. Dept. of Computer Science.
IMPLEMENTATION OF A DATA MANAGEMENT SOFTWARE SYSTEM FOR SSME TEST HISTORY DATA
Kenneth Abernethy *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 15 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

N87-16761*# Oakwood Coll., Huntsville, Ala. Dept. of Business and Information Systems Management.
AN EVALUATION OF THE DOCUMENTED REQUIREMENTS OF THE SSP UIL AND A REVIEW OF COMMERCIAL SOFTWARE PACKAGES FOR THE DEVELOPMENT AND TESTING OF UIL PROTOTYPES
Esther Naomi Gill *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 36 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

N87-16765*# Louisiana Tech Univ., Ruston. Dept. of Mechanical Engineering.
ELIMINATION SEQUENCE OPTIMIZATION FOR SPAR
Harry A. Hogan *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 23 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

N87-16769*# New Mexico State Univ., University Park.
BENCHMARKS OF PROGRAMMING LANGUAGES FOR SPECIAL PURPOSES IN THE SPACE STATION
Arthur Knoebel *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 29 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N87-16548# Naval Research Lab., Washington, D. C.
A SYSTEM FOR INTERACTIVE COMPUTER CONTROL OF EXPERIMENTS Memorandum Report, Sep. 1983 - Sep. 1985
T. A. Hargreaves and M. E. Read 25 Aug. 1986 139 p
(AD-A171873; NRL-MR-5743) Avail: NTIS HC A07/MF A01 CSCL 09/2

An integrated system allowing computer control and data acquisition has been developed for the NRL quasi-optical gyrotron experiment. The motivation for this system is manyfold. First, it is necessary to simultaneously monitor several parameters; a difficult task using only oscilloscopes but simple for a computer. Secondly, a computerized system is potentially much more accurate than an experimenter reading numbers off of an oscilloscope and recording them in a notebook. The use of the computer allows the experimenter to visually monitor only the parameters of immediate interest while the computer quietly records all of the necessary data for future analysis. Additionally, since the data is already in the computer, data analysis and plotting is transformed into a process that takes a few minutes instead of large fractions of hours. Because much of this analysis can be done while the experiment is running, the taking of useless data can be held to a minimum. These facts all result in the ability to take much more complete and accurate data in a shorter time period than otherwise would be possible. GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N87-16549*# Michigan Univ., Ann Arbor. Robotics Research Lab.
AN OVERVIEW OF TACTILE SENSING
Rajeev Agrawal and Ramesh Jain Jul. 1986 46 p
(Grant NAG2-350)
(NASA-CR-180126; NAS 1.26:180126; RSD-TR-11-86) Avail: NTIS HC A03/MF A01 CSCL 09B

Existing or proposed tactile sensors are reviewed. General considerations involved in tactile sensing and various performance criteria are discussed. Typical specifications to be expected from the sensors are also described. A representative set of present day tactile sensors is studied. Finally, some of the proposed recognition systems using tactile sensing are described. B.G.

N87-16550# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A NON-COGNITIVE FORMAL APPROACH TO KNOWLEDGE REPRESENTATION IN ARTIFICIAL INTELLIGENCE Ph.D. Thesis
Jim A. McMannama Jun. 1986 314 p
(AD-A172516; AFIT/DS/ENG/86J-1) Avail: NTIS HC A14/MF A01 CSCL 09/4

With the entry of Artificial Intelligence (AI) into real time applications, a rigorous analysis of AI expert systems is required in order to validate them for operational use. To satisfy this requirement for analysis of the associated knowledge representations, the techniques of formal language theory are used. A combination of theorems, proofs and problem solving techniques from formal language theory are employed to analyze language equivalents of the more commonly used AI knowledge representations of production rules (excluding working memory or situation data) and semantic networks. Using formal language characteristics, it is shown no single support tool or automatic programming tool can ever be constructed that can handle all possible production rule or semantic network variations. Also, it is shown that the entire set of finite production-rule languages is able to be stored in and retrieval from finite semantic network languages. In effect, the semantic network structure is shown to be a viable candidate for a centralized database of knowledge. GRA

N87-16551# Naval Postgraduate School, Monterey, Calif.
AN INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND ITS POTENTIAL USE IN SPACE SYSTEMS M.S. Thesis
Gary W. McDonald Jun. 1986 129 p
(AD-A174250) Avail: NTIS HC A07/MF A01 CSCL 22/2

This survey of Artificial Intelligence (AI) is based upon a review of its history, its philosophical development, and subcategories of its current technologies. These subcategories are expert systems, natural language processing, computer vision and pattern recognition, and robotics and autonomous vehicles. Emphasis is then directed toward the description of the fundamental characteristics of a generic space system, including the space bus components, mission system components, ground node functions, and system missions. It is concluded that AI, in site of its immaturity as a science, will prove to be a beneficial component of future space systems. GRA

N87-16778*# Alabama Univ., Huntsville. Dept. of Computer Science.
APPLICATIONS OF ARTIFICIAL INTELLIGENCE TO SCIENTIFIC RESEARCH
Mary Ellen Prince *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N87-16552*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF THE SOR ITERATION FOR THE 9-POINT LAPLACIAN Final Report
Loyce Adams, Randy LeVeque, and David Young Dec. 1986 40 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178212; ICASE-86-81; NAS 1.26:178212) Avail: NTIS HC A01/MF A01 CSCL 12A

The SOR iteration for solving linear systems of equations depends upon an overrelaxation factor omega. A theory for determining omega was given by Young (1950) for consistently ordered matrices. Here the optimal omega is determined for the 9-point stencil for the model problem of Laplace's equation on a square. Several orderings of the equations are considered, including the natural rowwise and multicolor orderings, all of which lead to non-consistently ordered matrices, and two equivalence classes of orderings are found with different convergence behavior and optimal omega's. The results for the natural rowwise ordering are compared to those of Garabedian (1956) and it is explained why both results are, in a sense, correct, even though they differ. Also analyzed is a pseudo SOR method for the model problem and it is shown that it is not as effective as the SOR methods. Finally, the point SOR methods are compared to known results for line SOR methods for this problem. Author

N87-16553*# Grumman Aerospace Corp., Bethpage, N.Y.
DYCAST: A FINITE ELEMENT PROGRAM FOR THE CRASH ANALYSIS OF STRUCTURES Final Report
A. B. Pifko, R. Winter, and P. Ogilvie Washington NASA Jan. 1987 344 p
(Contract NAS1-13148)
(NASA-CR-4040; NAS 1.26:4040) Avail: NTIS HC A15/MF A01 CSCL 12A

DYCAST is a nonlinear structural dynamic finite element computer code developed for crash simulation. The element library contains stringers, beams, membrane skin triangles, plate bending triangles and spring elements. Changing stiffnesses in the structure are accounted for by plasticity and very large deflections. Material nonlinearities are accommodated by one of three options: elastic-perfectly plastic, elastic-linear hardening plastic, or elastic-nonlinear hardening plastic of the Ramberg-Osgood type. Geometric nonlinearities are handled in an updated Lagrangian formulation by reforming the structure into its deformed shape after small time increments while accumulating deformations,

strains, and forces. The nonlinearities due to combined loadings are maintained, and stiffness variation due to structural failures are computed. Numerical time integrators available are fixed-step central difference, modified Adams, Newmark-beta, and Wilson-theta. The last three have a variable time step capability, which is controlled internally by a solution convergence error measure. Other features include: multiple time-load history tables to subject the structure to time dependent loading; gravity loading; initial pitch, roll, yaw, and translation of the structural model with respect to the global system; a bandwidth optimizer as a pre-processor; and deformed plots and graphics as post-processors. Author

N87-16554# Naval Underwater Systems Center, New London, Conn. New London Lab.
MAXIMUM-LIKELIHOOD ESTIMATION OF TIME-VARYING DELAY Technical Report, 1985 - 1986
John A. Stuller 30 Jul. 1986 71 p
(AD-A171818; NUSC-TR-7665) Avail: NTIS HC A04/MF A01 CSCL 17/1

This report presents, for the first time, the exact theoretical solution to the problem of maximum-likelihood (ML) estimation of time-varying delay, d(t), between a random signal, s(t), received at one point in the presence of uncorrelated noise and the time-delayed, scaled version as(t - d(t)) of that signal received at another point. Nonstationary Gaussian random process and the observation interval is arbitrary. GRA

N87-16555# Florida Univ., Gainesville. Dept. of Mathematics.
POSITIVE SOLUTIONS OF SYSTEMS OF SEMILINEAR ELLIPTIC EQUATIONS: THE PENDULUM METHOD
Joseph Glover 1986 34 p
(Grants NSF DMS-83-18204; AF-AFOSR-0330-85)
(AD-A171939; AFOSR-86-0677TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Conditions are formulated which guarantee the existence of positive solutions for simultaneous systems on an open domain with each constant is a positive measure. The main tools used are probabilistic potential theory, Markov processes, and an iterative scheme which is not a generalization of the one used for quasi-monotone systems. Quasi-monotonicity is not assumed and new results are obtained. GRA

N87-16556# California Univ., San Diego, La Jolla. Dept. of Mathematics.
NONLINEAR DIFFERENTIAL EQUATIONS IN GEOMETRY AND PHYSICS Annual Report
S. T. Yau 5 Sep. 1986 9 p
(Contract N00014-85-K-0367)
(AD-A173002) Avail: NTIS HC A02/MF A01 CSCL 12/1

During the past year a group of 12 graduate students, a visiting researcher and a postdoctoral fellow, supported in part by this contract, have studied various nonlinear partial differential equations. Seminars were held twice weekly on the topic of soliton theory. The graduate students involved have been studying the problem of singularity that arises in nonlinear equations. GRA

N87-16557# Mississippi State Univ., Mississippi State. Dept. of Aerophysics and Aerospace Engineering.
GENERATION OF SURFACE GRIDS THROUGH ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS FOR AIRCRAFT AND MISSILE CONFIGURATIONS Interim Report, Apr. 1985 - Mar. 1986
Z. U. Warsi 9 May 1986 20 p
(Grant AF-AFOSR-0143-85)
(AD-A172867; AASE-86-293; AFOSR-86-1068TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report is devoted to a computational method of mesh generation in arbitrary surfaces by utilizing a set of elliptic partial differential equations. These equations depend explicitly on the mean curvature and the unit normal vector of the surface in which the coordinates are to be generated. To determine the mean curvature for a given surface in global coordinates, first a piecewise least squares method is used to fit a surface through the given data points. Next, mesh generation results for various geometrically complicated shapes have been obtained to demonstrate the versatility of the proposed equations. An example of a monoclinic coordinate system with contraction in the coordinate leaving the surface has also been presented. GRA

N87-16558# Washington Univ., Seattle. Dept. of Applied Mathematics.
NONLINEAR RESONANCE Final Report, 1 Aug. 1983 - 31 Jul. 1986
1986 9 p
(Contract DE-AT06-83ER-13121)
(DE87-000752; DOE/ER-13121/6) Avail: NTIS HC A02/MF A01

Research is concerned with applied mathematics, especially mathematical physics. Research related to resonant wave interactions, adiabatic invariants which survive resonance passage, the dynamics of a free-electron laser with variable parameter wiggler, and a survey of techniques and results for nonlinear oscillatory systems with slowly varying coefficients is summarized. DOE

N87-16026*# TRW, Inc., Redondo Beach, Calif.
APPLICATION OF PHYSICAL PARAMETER IDENTIFICATION TO FINITE ELEMENT MODELS
Allen J. Bronowicki, Michael S. Lukich, and Steven P. Kuritz *In* NASA. Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 Nov. 1986 p 187-206 (For primary document see N87-16014 08-18)
Avail: NTIS HC A23/MF A01 CSCL 12A

N87-16377# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
INTRODUCTION TO FINITE ELEMENT BASICS
A. J. Morris *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design Aug. 1986 35 p (For primary document see N87-16376 08-39)
Avail: NTIS HC A07/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N87-16559*# Research Triangle Inst., Research Triangle Park, N.C. Center for Digital Systems Research.
EVALUATION OF RELIABILITY MODELING TOOLS FOR ADVANCED FAULT TOLERANT SYSTEMS Final Report
Robert Baker and Charlotte Scheper Oct. 1986 159 p
(Contract NAS1-16489)
(NASA-CR-178067; NAS 1.26:178067) Avail: NTIS HC A08/MF A01 CSCL 14D

The Computer Aided Reliability Estimation (CARE III) and Automated Reliability Interactice Estimation System (ARIES 82) reliability tools for application to advanced fault tolerance aerospace systems were evaluated. To determine reliability modeling requirements, the evaluation focused on the Draper Laboratories' Advanced Information Processing System (AIPS) architecture as an example architecture for fault tolerance aerospace systems. Advantages and limitations were identified for each reliability evaluation tool. The CARE III program was designed primarily for analyzing ultrareliable flight control systems. The ARIES 82 program's primary use was to support university research and teaching. Both CARE III and ARIES 82 were not suited for determining the reliability of complex nodal networks of the type used to interconnect processing sites in the AIPS architecture. It was concluded that ARIES was not suitable for modeling advanced fault tolerant systems. It was further concluded that subject to some limitations (the difficulty in modeling systems with unpowered spare modules, systems where equipment maintenance must be considered, systems where failure depends on the sequence in which faults occurred, and systems where multiple faults greater than a double near coincident faults must be considered), CARE

III is best suited for evaluating the reliability of advanced tolerant systems for air transport. Author

N87-16560# South Carolina Univ., Columbia. Dept. of Psychology.
CONJUNCTIVE ITEM RESPONSE THEORY KERNELS Research Report, 1 May - 15 Aug. 1986
Robert J. Jannarone Aug. 1986 43 p
(Contract N00014-86-K-0817; RR0-4204)
(AD-A171839; Rept-86-1-ONR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Conjunctive item response models are introduced such that (a) sufficient statistics for latent traits are not necessarily additive in item scores; (b) items are not necessarily locally independent; and (c) existing compensatory (additive) item response models incases. Simple estimates and hypothesis tests for conjunctive models are introduced and evaluated as well. Conjunctive models are also identified with cognitive models that assume the existence of several individually necessary component processes for a global ability. It is concluded that conjunctive models and methods may show promise for constructing improved tests and uncovering conjunctive cognitive structure. It is also concluded that conjunctive item response theory may help to clarify the relationships between local dependence, multidimensionality, and item response function form. GRA

N87-16561# North Carolina Univ., Chapel Hill. Dept. of Statistics.
DIAGNOSTICS AND ROBUST ESTIMATION WHEN TRANSFORMING THE REGRESSION MODEL AND THE RESPONSES Technical Report, Aug. 1985 - Aug. 1986
R. J. Carroll and David Ruppert Oct. 1985 44 p
(Contract F49620-85-C-0144; Grant NSF DMS-84-00602)
(AD-A171938; MMS-1592; AFOSR-86-0682TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

In regression analysis, the response is often transformed to remove heteroscelasticity and/or skewness. When a model already exists for the untransformed response, then it can be preserved by transforming both the model and the response with the same transformation. This methodology, which is called transform both sides has been applied in several recent papers, and appears highly useful in practice. When a parametric transformation family such as power transformations is used, then the transformation can be estimated by maximum likelihood (MLE). The MLE however is very sensitive to outliers. This article proposes diagnostics which indicate cases influential for the transformation regression parameters. We also propose a robust bounded-influence estimator similar to the Krasker-Welsch regression estimate. Both diagnostics and the robust estimator can be implemented on standard software. Author (GRA)

N87-16562# Illinois Univ., Urbana. Dept. of Psychology.
COMPARATIVE ACCURACY OF FIVE INDICES OF DIMENSIONALITY OF BINARY ITEMS
Ledyard R. Tucker, Lloyd G. Humphreys, and Mary A. Roznowski Jan. 1986 46 p
(Contract N00014-84-K-0186)
(AD-A172110) Avail: NTIS HC A03/MF A01 CSCL 12/1

A Monte Carlo study of five indices of dimensionality of binary items has been conducted using a computer model that allowed sampling of both items and people. Five parameters were systematically varied in a factorial design: (1) number of common factors from one to five; (2) number of items, including 20, 30, 40, and 60; (3) sample sizes of 125 and 500; (4) nearly rectangular and highly peaked distributions of item difficulties; and (5) factor intercorrelations averaging in the thirties and in the fifties. Accuracy in distinguishing one factor from more than one was the criterion. An index involving variance-covariance matrices and based on the unidimensional property of local independence of items was overall most accurate. This index and an index based on ratios of differences in successive Eigenvalues were substantially more accurate in the peaked than in the rectangular distributions of item difficulties. An index based on the pattern of second principal factor loadings obtained in product-moment correlation matrices showed the reverse pattern. For all indices there is an increase in accuracy as both sample size and number of items is increased: for all indices there is a decrease in accuracy as factor intercorrelations are increased and as the number of factors is increased. Author (GRA)

N87-16762*# Jackson State Univ., Miss. Dept. of Mathematics.
STRATIFIED PROCESSES TO ANALYZE SSME PARTS AND SUBSYSTEMS USING WEIBULL METHODOLOGY
Lou Allen Bell Gray *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14D

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N87-16563# Georgia Inst. of Tech., Atlanta.
EXTREME VALUES OF QUEUES, POINT PROCESSES AND STOCHASTIC NETWORKS Annual Technical Report, 30 Sep. 1984 - 30 Sep. 1985
Richard F. Serfozo Nov. 1985 12 p
(Grant AF-AFOSR-0367-84)
(AD-A172013; AFOSR-86-0721TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

Work progressed on four topics. In modeling of stochastic flows in networks, compound Poisson approximations for random variables and point processes were developed. In extremal problems in stochastic networks, a family of bounds for the distributions of certain generic random variables were obtained. In optimization of queueing systems, progress was made in determining ways to control or dampen extremes of queues. Finally, research was begun on extreme values of queues and point processes. Author (GRA)

N87-16004# Science Applications International Corp., Huntsville, Ala.
LETHAL AIR DEFENSE SUPPRESSION TECHNOLOGY BASE DEFINITION
Harold L. Pastrick, John A. Frech, William R. Day, and Anthony Biele (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 10 p (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

N87-16006# National Aerospace Lab., Amsterdam (Netherlands).
TACTICAL MISSION PLANNING AND MANAGEMENT
P. J. M. Urlings and A. L. Spijkervet *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Jun. 1986 9 p Previously announced as N87-14198 (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

N87-16009# Electronique Serge Dassault, St. Cloud (France).
GUIDED STAND-OFF WEAPONS AND THE EVALUATION OF MEANS FOR LAUNCH CALCULATION: THE APPLICATION OF NEW TECHNIQUES [LES ARMES GUIDEES TIREES A DISTANCE DE SECURITE ET L'EVOLUTION DES MOYENS DE CALCUL EMBARQUE: L'APPORT DES TECHNIQUES NOUVELLES]
J. P. Quemard *In* AGARD Guidance, Control and Positioning of Future Precision Guided Stand-Off Weapons Systems Oct. 1985 8 p In FRENCH (For primary document see N87-16000 08-15)
Avail: NTIS HC A12/MF A01

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N87-16564# Argonne National Lab., Ill.
LIQUID-METAL FLOW IN A THIN CONDUCTING PIPE NEAR THE END OF A REGION OF UNIFORM MAGNETIC FIELD
J. S. Walker Apr. 1986 42 p Prepared in cooperation with Illinois Univ., Urbana
(Contract W-31-109-eng-38)
(DE86-015006; ANL/FPP/TM-205) Avail: NTIS HC A03/MF A01

This paper treats the liquid-metal flow in a straight circular pipe with a thin metal wall. A strong magnetic field is applied by a magnet with parallel poles that end abruptly. In the plane midway between the magnet poles: (1) far upstream, the flow is uniform, fully developed flow in a uniform magnetic field; (2) as the flow enters the non-uniform magnetic field near the end of the magnet, the flow moves away from the central part of the pipe and becomes concentrated as two jets near the points where the magnetic field is tangent to the pipe wall; (3) further downstream where the magnetic field strength is 0(c/sup 1/6/) compared to its value upstream, the flow migrates from these jets back toward a uniform flow distributed over the entire pipe cross section. Here, c is the wall conductance ratio, which is assumed to be small. The analysis also applies to flow into the magnetic field, because inertial effects and induced magnetic fields are neglected. There are circulations of electric current in planes parallel to the magnet poles. These currents produce a pressure drop in addition to that for two fully developed flows, one in a uniform magnetic field and one in no magnetic field, joined at the end of the magnet. DOE

N87-16565# Wisconsin Univ., Madison. Dept. of Physics.
DIFFUSION OF MAGNETIC FIELDS INTO CONDUCTORS OF NON-UNIFORM RESISTIVITY
J. C. Sprott Aug. 1986 28 p
(Contract DE-FG02-85ER-53198)
(DE87-000280; DOE/ER-53198/96) Avail: NTIS HC A03/MF A01

Solutions are obtained for the spatial variation of electrical resistivity of cylindrical and rectangular conductors such that the magnetic field external to the conductor maintains a constant spatial variation as the magnetic field diffuses into the conductor. Practical implementations of the ideal solution are described. DOE

N87-16566# National Bureau of Standards, Gaithersburg, Md. Public Information Div.
NBS (NATIONAL BUREAU OF STANDARDS) RESEARCH REPORTS, JULY 1986
Jul. 1986 37 p
(PB87-104741; NBS/SP-719; LC-86-600556) Avail: NTIS HC A03/MF A01 CSCL 20C

NBS (National Bureau of Standards) Research Reports, July 1986, contains the following: Research update; Spirit of cooperation alive and well at National Bureau of Standards; Taking the Earth's measure at a unique institution; Gravity, when you get right down to it; The light fantastic, Safer, quicker ways to prepare samples for chemical analysis; Researchers study the process to improve measurement accuracy; Expanded version of IGES standard available; NBS studying new techniques to identify irradiated foods; NBS research in biotechnology: Providing the scientific fundamentals; New publications; Conference calendar. GRA

N87-16567# National Bureau of Standards, Gaithersburg, Md.
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 91, NUMBER 3, MAY - JUNE 1986
Jun. 1986 166 p
(PB87-100186) Avail: NTIS HC A08/MF A01 CSCL 20C

The Journal of Research of the National Bureau of Standards, Volume 91, Number 3, May - June 1986, lists the following table of contents: High precision microcalorimetry: Apparatus, procedures, and biochemical applications; Standards development for differential scanning calorimetry; Miniature mercury contact switches for instrument temperature control; Thermophysical property measurement on chemically reacting systems-a case study; Inorganic materials biotechnology; A new industrial measurement challenge; Improvements in the application of the numerical method of characteristics to predict attenuation in unsteady partially filled pipe flow. GRA

N87-16568# Joint Publications Research Service, Arlington, Va.
USSR REPORT: PHYSICS AND MATHEMATICS
23 May 1986 139 p Transl. into ENGLISH from various Russian articles
(JPRS-UPM-86-007) Avail: NTIS HC A07/MF A01

Abstracts of papers and articles addressing various topics in pure and applied physics and mathematics are compiled. Subject areas include: lasers and laser-target interactions, fluid dynamics, plasma physics, optics, game theory and decision making, numerical analysis, and statistics and probability. For individual titles, see N87-16569 through N87-16581.

N87-16569# Joint Publications Research Service, Arlington, Va.
SINGLE CRYSTALS OF ZnSe(1-x)Te(x), Zn(1-x)Cd(x)Se, Zn(x)Cd (1-x)S SOLID SOLUTIONS FOR LASERS WITH ELECTRON-BEAM PUMPING Abstract Only **c36**
A. M. Akhekyan, V. I. Kozlovskiy, Yu. V. Korostelin, A. S. Nasibov, Yu. M. Popov, and P. V. Shapkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 3 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1113-1115 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

Blue lasers are now produced with ZnSe single crystals (450 nm wavelength) grown from the vapor phase, or epitaxially from organo-element compounds, or from the melt after additional high-temperature annealing in liquid zinc. Increasing the laser power above 3 W, with liquid-nitrogen cooling, to match the eye sensitivity at this wavelength requires larger single crystals and better electron-beam scanning. As a practical alternative, shifting the radiation wavelength into the 470-480 nm band, where the eye sensitivity is much better, has been considered. Raising the temperature of a ZnSe single crystal to room level will, however, either lower its emission power or shorten its life. Another solution to the problem is sought in replacement of ZnSe with ternary compounds ZnSe(1-x)Te(x), Zn(1-x)Cd(x)Se, Zn(x)Cd (1-x)S or certain quaternary ones. Single crystals of those ternary compounds were successfully grown from the gaseous phase on seeding substrates in a sealed crucible inside an electric resistance furnace, ingots 30-50 mm in diameter and up to 50 mm high after 80 hours of pulling. Their cathodoluminescence spectra were measured and compared with those of ZnSe single crystals, all specimens being cooled with liquid nitrogen while pumped with 50 keV electrons electrons at current densities from 10(-5) to 200 A/cm(2). Specimens of each kind were used as active laser medium, with a resonator formed by a 40 micron thick semiconductor wafer with an opaque coating (92% reflection) facing the electron beam for longitudinal pumping on one side and an semitransparent 6-layer interference coating (93% reflection) on the opposite side. A comparative evaluation of their performance characteristics indicates that the ZnSe(1-x)Te(x) group is unsuitable, because the emission line shifts fast toward shorter wavelengths while the longer-wave radiation saturates fast, hypothetically owing

to formation of a deep level above the valence band. It also indicates that the performance of the Zn(1-x)Cd(x)Se group will not be significantly improved by increasing x, but hopefully by high-temperature annealing. Author

N87-16570# Joint Publications Research Service, Arlington, Va.
INTERACTION OF AIR SHOCK WAVES AND POROUS COMPRESSIBLE MATERIALS Abstract Only c34
L. G. Gvozdeva, Yu. M. Faresov, and V. P. Fokeyev *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 11-12 Transl. into ENGLISH from Zhurnal Prikladnoy Mekhaniki i Tekhnicheskoy Fiziki (Novosibirsk, USSR), no. 3, May - Jun. 1985 p 111-115 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

Interaction of air shock waves and porous compressible materials was studied in an experiment with two foam-plastic materials: PPU-3M-1 polyurethane (density 33 kg/cu m) and much more rigid PKhV-1 polyvinyl chloride (density 50 kg/cu m). Tests were performed in a shock tube with 0.1x0.1 m square cross-section, a single diaphragm separating its 8 m long low-pressure segment with inspection zone and 1.5 m long high-pressure segment. The instrumentation included an array of piezoelectric pressure transducers and a digital frequency meter for velocity measurements, a Tectronix 451A oscillograph, and IAB-451 shadowgraph, and a ZhFR camera with slit scanning. Air was used as compressing gas, its initial pressure being varied from 10(3) Pa to 10(5) Pa, helium and nitrogen were used as propelling gas. The impact velocity of shock waves was varied over the N(M) = 2-5 range of the Mach number. The maximum amplitude of the pressure pulse increased as the thickness of the foam layer was increased up to 80 mm and then remained constant with further increases of that thickness, at a level depending on the material and on the intitial conditions. A maximum pressure rise by a factor of approximately 10 was attained, with 1.3 x 10(3) Pa initial pressure and an impact velocity N(M) = 5. Reducing the initial pressure to below (0.1-0.3) x 10(3) Pa, with the impact velocity maintained at N(M) = 5, reduced the pressure rise to a factor below 3. The results are interpreted taking into account elasticity forces in the solid skeleton phase and gas filtration through the pores. Author

N87-16571# Joint Publications Research Service, Arlington, Va.
SPECTRAL AND TEMPORAL CHARACTERISTICS OF HIGH-POWER NEODYMIUM GLASS LASER EMPLOYING CASCADE FREQUENCY CONVERSION IN VACUUM ULTRAVIOLET REGION Abstract Only c36
Yuriy Vasilyevich Korobkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 24 Transl. into ENGLISH from the mono. "Spektralnyye i Vremennyye Kharakteristiki Moshchnogo Lazera na Neodimovom Stekle s Kaskadny, Preobrazovaniyem Chastoty v Oblast Vakuumnogo Ultrafioleta" Moscow, USSR, 1984 p 3-20 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

This study describes the development and investigation of a subnanosecond and picosecond source of pulse coherent radiation with output characteristics variable in the infrared, visible, and ultraviolet regions of the spectrum. Systems for recording the temporal parameters of supershort laser pulses are investigated. The generation of coherent radiation in the vacuum ultraviolet region is studied. The way in which the spatial coherence of the radiation field of a light wave changes when the radiation from a subnanosecond mode-locked laser is converted to higher-order harmonics in nonlinear crystals is established. The influence of confining processes on conversion efficiency as the pumping wavelength changes is studied experimentally, indicating that the increase in the nonlinear susceptance of Xe as the wave discrepancy becomes smaller has practically no effect on conversion efficiency due to the increased absorption of Xe in the region of the 9th harmonic, as well as the change in the index of refraction of Xe. Author

N87-16572# Joint Publications Research Service, Arlington, Va.
MECHANISM LIMITING OPTIMUM EMISSION PULSE REPETITION RATE OF LASERS ON SELF-LIMITED TRANSITIONS IN METAL VAPORS Abstract Only c36
P. A. Bokhan *In its* USSR Report: Physics and Mathematics (JRPS-UPM-86-007) 23 May 1986 p 26 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 945-952 Original language document was announced in IAA as A85-43302 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

The pulse repetition characteristics of lead-vapor lasers (wavelength 0.723 micron) have been investigated experimentally using electron beam (EB) and gas discharge (GD) excitation. The time tau at which laser action begins to relax under dual pulse excitation by the electron beam was about 1 microsecond. Emission power in the GD laser began to fall off when tau was equal to about 0.1 ms. The energy per unit volume ratio of the EB metal vapor laser was two times greater than that of the GD laser, and the optimum pulse repetition rate was two orders of magnitude higher. The average emission power of the EB laser was about 400 W/m. The mechanism determining the optimum plasma repetition rate in the EB laser, plasma recombination, was found to be the same in GD lasers using Cu and Mn vapors. IAA

N87-16573# Joint Publications Research Service, Arlington, Va.
CONTROLLING SPIKE EMISSION MODE OF TWO-COMPONENT HETEROSTRUCTURE LASER Abstract Only c36
I. S. Goldobin, V. N. Lukyanov, A. F. Solodkov, and S. D. Yakubovich *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 27 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 3, May 1985 p 953-958 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

Two-component injection lasers on semconductor heterostructures, such as GaAl/As with space-nonuniform excitation, are eminently suitable for measurements, as well as data transmission and processing, since spike emission is one of their characteristic operating modes. The conditions for stabilization of this mode within the ambiguity range of their S-curve power-current characteristic are examined analytically on the basis of a model which consists of three equations describing the emission dynamics in terms of injection current density and excess charge carrier concentration kinetics. Thermal processes and boost pumping of weak-injection regions with superluminescence radiation are disregarded, as are also the modal content of emitted radiation and the stochastic nature of spontaneous emission. Calculations reveal unexpectedly that within a narrow threshold range of ambiguous solutions the phase trajectories, depending on the intial conditions, converge either to a stable point which corresponds to spontaneous emission or to a limit cycle containing an instability point which corresponds to spike emission. Calculations yield also the dependence of the self-modulation frequency and of the fundamental-harmonic amplitude in the radio-frequency spectrum on the pumping current, the frequencies of self-modulation locking with a harmonic external signal, the photochronograms of a spike, and the spectrum of spike sequences. On the basis of these results the amplitude-frequency characteristics of an LFD-2 photodiode and an ELU-FTK fast photomultiplier are calculated. These characteristics have been checked and calibrated against measurements made and oscillograms taken on two-component semiconductor homostructure lasers. Author

N87-16574# Joint Publications Research Service, Arlington, Va.
EFFECT OF PARAELECTRODE PROCESSES ON CONTRACTION OF SPACE CHARGE IN PERIODIC-PULSE LASERS Abstract Only c36
R. V. Arytyunyan, V. Yu. Baranov, V. M. Borisov, A. Yu. Vinokhodov, and Yu. B. Kiryukhin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 28 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 971-976 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

A characteristic feature of periodic-pulse electric-discharge

CO2-lasers and excimer lasers is contraction of the space charge as the pulse repetition rate increases. The emission energy per pulse decreases as a consequence, with the average laser power first ceasing to increase linearly beyond a certain corner repetition rate and then decreasing beyond a certain critical repetition rate. A study of this phenomenon was made, for the purpose of separating the effect of paracathode processes from the effect of gas dynamics and then evaluating the effect of the former alone. Paraelectrode perturbations were simulated by focusing the radiation from the an XeCl-laser on the cathode surface in an atmosphere of nonabsorbing gases. Laser pulses of up to approximately 0.5 J energy and of approximately 50 ns duration were focused within a spot of 1 mm(2) area on a cathode inside a discharge chamber, with the power density of incident radiation regulated by means of an attenuator. A space charge within a volume of 2.5x4.5x9 cm(3) was generated between this specially shaped cathode and a mesh anode with an approximately 50% optical transmission coefficient. The space charge in helium and in neon was photographed, and the time lag of a discharge pulse behind a contracting laser pulse was measured as a function of the laser pulse energy for these two gases, as well as for a He+C12 gas mixture. The general trend was found to be the same in each case, the time lag increasing with increasing energy first at a slower rate up to a critical energy level and then faster. It has been established that plasma does not build up on the cathode before the laser pulse energy reaches 30 mJ (for a 3 mm(2) surface area), while plasma glow begins as the laser pulse energy reaches 150 mJ. A contracted channel begins to form within the laser-cathode interaction space, with an attendant fast increase of the time lag owing to evaporation of the cathode metal. Author

N87-16575# Joint Publications Research Service, Arlington, Va.
ACTIVATED LiF CRYSTALS AS NOVEL ACTIVE MEDIA FOR TUNABLE LASERS Abstract Only **c36**
I. A. Parfianovich, V. M. Khulugurov, N. A. Ivanov, A. A. Mikhalenko, V. A. Chepurnoy, and A. P. Shkadarevich *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 46 Transl. into ENGLISH from the book "Perestraivayemyye po Chastote Lazery" Novosibirsk, USSR, 1984 p 98-104 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

An experimental study of LiF:OH and LiF:Me(2+) (Me = Mg, Ni, Co) crystals was made, for establishing their suitability as active laser media. Specimens of these crystals were grown by the Kiropulos method in air, injection of OH ions being facilitated by moistening the raw material and then comminuting it so as to increase its active surface area. The LiF:OH crystals were activated with up to 10(8) R doses of gamma-radiation from a Co-60 source at temperatures below 250 K, then pumped with second-harmonic radiation from a YAG laser. The LiF:Me(2+) crystals were activated with up to 10(8) R doses of x-radiation, then pumped with second-harmonic radiation from a neodymium laser. The resonator was formed by two plane mirrors with respective reflection coefficients of 0.98 and 0.35 within the 750-1100 nm emission range, and each with a reflection coefficient of 0.1 at the 532 nm wavelength. Their spectra and the luminescence spectra of their unstable and stable F(2)+ color centers were measured, along with their energy characteristics in terms of efficiency as a function of wavelength and pumping power density. The results indicate the feasibility of operating such lasers for only 10-15 h at room temperature owing to thermal breakdown of E(2)+* centers but almost indefinitely at 270 K owing to thermal stabilization of F(2)+* centers. Author

N87-16576# Joint Publications Research Service, Arlington, Va.
NARROWING AND SHIFTING EMISSION LINE OF DYE LASER BY MEANS OF IODINE VAPOR ATTACHMENT Abstract Only **c36**
V. A. Alekseyev, B. A. Konstantinov, T. I. Mikhalina, B. F. Trinchuk, N. G. Ustinov, and A. V. Shulenin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 47-48 Transl. into ENGLISH from the book "Perestraivayemyye po Chastote Lazery" Novosibirsk, USSR, 1984 p 349-351 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

The characteristic feature of I2-molecules, namely, the dense spectrum of vibrational-rotational levels in their combining electron states making the mean distance between their emission lines comparable with the width of their Doppler contour, has been experimentally utilized for narrowing the emission lines of continuously-pumped tunable dye lasers. In one such experiment iodine vapor was used during pumping of an LZhl-406 dye laser with a coaxial flashtube. Use of iodine vapor during pumping of etalon dye lasers on coumarin-30, coumarin-7, and rhodamine-6Zh emitting pulses of 1 micro-sec duration and 0.1-50 mJ energy, made possible the narrowing of their emission lines from 1.5 nm to 0.0035 nm and smooth tuning over the 500-610 nm range, through Fabry-Perot interferometers with 5100 nm and 1000 nm bases. The iodine-vapor cell was 265 mm long and 16 mm in diameter, with Brewster window. The saturated-vapor pressure was regulated by varying the temperature of the extension pipe. The resonator for this iodine-vapor pumping laser was formed by two plane mirrors with a 1.9 mm thick quartz-plate selector. Its emission spectrum was found to consist of approximately 5 x 10(5) lines within the 0.66-1.25 micron range of wavelengths. Author

N87-16577# Joint Publications Research Service, Arlington, Va.
POSSIBILITY OF CONTROLLING LASER RADIATION BY MEANS OF STIMULATED MANDELSHTAM-BRILLOUIN SCATTERING IN OPTICAL FIBER Abstract Only **c36**
Ye. A. Kuzin and M. P. Petrov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 53 Transl. into ENGLISH from Pisma v Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 11, no. 7, 12 Apr. 1985 p 389-393 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

The possibility of switching high-intensity radiation by means of stimulated Mandelstam-Brillouin scattering in an optical fiber is considered, this being one particular manner of controlling high-intensity light beams by low-power light pulses in a nonlinear medium. In the simplest scheme powerful pumping radiation at some frequency passes through a semi-transparent plate and a lens before it enters an optical fiber. In the absence of control this radiation passes through the fiber without obstacles and reaches an output channel at the fiber exit. When a control radiation from a source at the fiber exit is simultaneously sent through the fiber in the opposite direction, at a frequency equal to the pump frequency minus the frequency shift caused by Mandelstam-Brillouin scattering, then nonlinear interaction of the two waves produces a hypersonic wave in the fiber. Subsequent interaction of the three waves can result in a complete transfer of energy from the pumping wave to the control wave, with the latter now carrying all radiation into another channel at the fiber entrance. An estimate of the control radiation power necessary for such a switching is made on the basis of the two equations $dL(S)/dz = -gI(S)I(P)$ and $dI(P)/dz = -gI(S)I(P)$ in the theory of steady-state Mandelstam-Brillouin scattering with a stokes wave carrying the control radiation. For a quartz fiber such an estimate yields a control pulse of 2.5 x 10(-9) J energy or approximately 25 MW for a switching speed of the order of 100 ns, considering that the relaxation time for a hypersonic wave in fused quartz is of the order of 10 ns. This estimate was verified experimentally. Author

N87-16578# Joint Publications Research Service, Arlington, Va.
MAXIMUM GAIN OF MULTISTAGE LASER AMPLIFIER Abstract Only **c36**
A. I. Makarov and A. K. Potemkin *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 71-72 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1054-1056 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

The problem of self-focusing of powerful laser pulses on thermonculear targets with wavefront reversing mirrors is consid-

ered, this operation requiring a laser amplifier with a gain higher than 10(4). Difficulties in producing such an amplifier are caused essentially by superluminescence and self-excitation, the former resulting in depletion of the active transition and the latter resulting from parasitic reflections, as well as from backscattering along rough surfaces of the active cell or optical components. It therefore is important to establish the maximum gain attainable with a laser amplifier. This is done here for a laser on neodynamic glass with a cylindrical active cell. The energy density of spontaneous noise at the amplifier output is calculated first of all, assuming an optimum luminaire geometry and a sufficiently long cell so that the gain is neither a function of transverse coordinates nor a function of the viewing angle. Calculations are made first for a single-stage amplifier and then for an amplifier with additional stages. Estimates based on an active cell made of GLS1 glass yield a gain of the order of 10(7) when the viewing angle does not exceed 3 mrad. These estimates have been verified and confirmed experimentally on a two-pass four-stage amplifier with glass rods 10mm in diameter at the Brewster angle. The results overall indicate the feasibility of a high-gain laser amplifier, but also that superluminescence even when propagating at low angle to the axis will limit the gain to the 10(7) level. Author

N87-16579# Joint Publications Research Service, Arlington, Va.
ACCOUNTING FOR QUANTUM NOISE IN ADAPTIVE FOCUSING OF OPTICAL RADIATION Abstract Only **c74**
V. A. Loginov and V. Ye. Antsiperov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 72-73 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1009-1016 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

Adaptive focusing of optical radiation is considered, particularly minimization of the effect of quantum noise during recording of a signal by a detector and measurement of its phase distribution over the aperture for the purpose of wavefront correction. A self-luminous object is assumed to lie in some plane cutting through the atmosphere at a distance S away from the receiver-transmitter aperture, and the detector is placed behind the aperture at a distance Z. The problem of maximizing the power transmitted to the object, which will brighten the latter up, is formulated as the problem of finding the field distribution in the plane of the aperture which will yield the maximum payoff in terms of average power on the object at fixed a priori and a posteriori data, in the Bayes sense. The optimum control algorithm is constructed on this basis and on the basis of three physically permissible simplifying assumptions. With the approximation of Gaussian exponential functions, the integral equation representing the condition for power maximality and obtained by the method of indeterminate Lagrange multipliers reveals that the control algorithm, as well as both a posteriori and mean payoffs, depend on two receiver parameters which must be determined. These are intensity F(0) of a normally incident plane wave focused on the detector at the point of zero argument and its characteristic dimension 2F(0)/F''(0). The algorithm will then prescribe the optimum phasefront slope and the radiation intensity taper from center to edge of the aperture corresponding to maintenenace of full power. The optimum average power on the object is then expressed as the sum of an asymptotically converging infinite series and evaluated as such, taking into account the diffraction spot produced by the aperture in the plane of the object. Author

N87-16580# Joint Publications Research Service, Arlington, Va.
STRUCTURE AND PROPERTIES OF OPTICAL-DISCHARGE PLASMA IN CO2-LASER BEAM NEAR TARGET SURFACE Abstract Only **c75**
Ye. V. Danshchikov, V. A. Dymshakov, F. V. Lebedev, and A. V. Ryazanov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 91-92 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1002-1008 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

An experimental study of optical-discharge plasma in a CO2-laser beam at a target surface was made for the purpose of exploring the not yet understood role of this plasma in the laser-target interaction process. Such a plasma was produced by means of a quasi-continuous CO2-laser with an unstable resonator, its power being maintained constant for 1 ms periods. Its radiation was focused on the surfaces of thick and seeding thin Al, Ti, and Ta targets inclined at an approximately 70 deg. angle to the beam, inside a hermetic chamber containing air, argon, or helium under atmospheric pressure. The radiation intensity distribution over the focal plane and the nearest caustic surface in the laser beam was measured along with the plasma parameters, the latter by the methods of spectral analysis and photoelectric recording. The instrumentation for this purpose included an MDR-3 monochromator with an entrance slit, a double electron-optical converter, a memory oscillograph, and an SI-10-30 ribbon lamp as radiation reference standard. The results yielded integral diametral intensity distributions of the emission lines Ti-II (457.2 nm), Ti-I (464 nm), Ar-II (462 nm), radial and axial temperature profiles of optical discharge in metal vapor in surrounding gas, and the radial temperature profile of irradiated metal surface at successive instants of time. The results reveal marked differences between the structures and the properties of optical-discharge plasma in metal vapor and in surrounding gas, optical discharge in the former being characterized by localization within the laser beam and optical discharge in the latter being characterized by a drift away from the target. Author

N87-16581# Joint Publications Research Service, Arlington, Va.
MODELING OF PRESSURE WAVES FORMED DURING DETONATION AND COMBUSTION OF GAS MIXTURES Abstract Only **c34**
A. A. Borisov, V. Ye. Gelfand, and S. A. Tsyganov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 113 Transl. into ENGLISH from Fizika Goreniya i Vzryva (Novosibirsk, USSR), v. 21, no. 2, Mar. - Apr. 1985 p 90-97 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

A comparative analysis is presented of the data in the literature on explosions of explosives and gas mixtures based on so-called energy similarity curves, where the pressure and impulse field for the explosive is represented as a function of the reduced radius referred to the cube root of the energy, or to the radius of the charge. It is found possible to formulate energy similarity laws for spherical detonation explosions of clouds of gaseous mixtures in terms of pressure and impulse, and that existing data are described by a unified relationship, within the limits of acceptable experimental error. Inasmuch as the experimental errors are fairly large, however, it is inadvisable to use the so-called trotyl equivalent as a rigorous quantitative characteristic. Author

N87-16582# Joint Publications Research Service, Arlington, Va.
USSR REPORT: PHYSICS AND MATHEMATICS
14 Jan. 1987 111 p Transl. into ENGLISH from various Russian articles
(JPRS-UPM-87-001) Avail: NTIS HC A06/MF A01

Topics addressed include: crystals, laser glasses, and semiconductors; lasers; magnetohydrodynamics; nuclear physics; optics and spectroscopy; plasma physics; superconductivity; technical physics; theoretical physics; logic and game theory; numerical analysis and algorithms; control systems; and control theory. For individual titles, see N87-16583 through N87-16584.

N87-16583# Joint Publications Research Service, Arlington, Va.
ON POSSIBLE APPLICATIONS OF MOESSBAUER SPECTROSCOPY FOR THE DETERMINATION OF SOUND FIELD TOPOGRAMS IN LIQUIDS **c71**
A. R. Arakelyan, E. M. Arutyunyan, and M. M. Slavinskiy *In its* USSR report: Physics and Mathematics (JPRS-UPM-87-001 14 Jan. 1987 p 49-52 Transl. into ENGLISH from Izvestiya Akademii Nauk Armyanskoy SSR (Yerevan, USSR), v. 20, no. 5, Sep. - Oct. 1985 p 278-281 (For primary document see N87-16582 08-70)
Avail: NTIS HC A06/MF A01

The possibility of estimating the characteristics of sound fields in liquids on the basis of modulating Mossbauer gamma-resonance radiation by external acoustic vibrations was studied. The formation and propagation of low-frequency vibrations were studied in a water medium. Measurements of sound fields were also made at various depths in the cross section of the acoustic beam, producing a topogram of the field in water. It is shown that the method of gamma-acoustic spectroscopy can be used to measure the characteristics of sound fields in water media with a good accuracy. B.G.

N87-16584# Joint Publications Research Service, Arlington, Va.
EXOTIC SUPERCONDUCTORS c76
Aleksandr Ivanovich Buzdin and Viktor Vasilyevich Moshchalkov *In its* USSR report: Physics and Mathematics (JPRS-UPM-87-001) 14 Jan. 1987 p 59-80 Transl. into ENGLISH from Novoye v Zhizni, Nauke, Technike: Seriya Fizika (Moscow, USSR), no. 5, May 1986 p 100-101 (For primary document see N87-16582 08-70)
Avail: NTIS HC A06/MF A01

The birth of exotic superconductors occurred at the very end of the 1970s, owing their creation to the impressive successes in the synthesis of new materials. The prospect for the practical use of their amazing properties is very promising, and they await their embodiment in specific developments. From the viewpoint of fundamental science, exotic superconductors have already provided much for low-temperature physics, in particular explaining the connection between superconductivity and magnetism. Superconductors with heavy fermions as well as magnetic and organic superconductors are discussed. B.G.

N87-16188# Joint Publications Research Service, Arlington, Va.
ROTATION OF SOLID BODY IN MAGNETIC FIELD
V. V. Kozlov *In its* USSR Report: Engineering and Equipment 26 Aug. 1986 p 44 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Tverdogo Tela (Moscow, USSR), no. 6, Nov. - Dec. 1985 p 28-33 Original language document was announced in IAA as A86-24283 (For primary document see N87-16186 08-31)
Avail: NTIS HC A05/MF A01

N87-16747*# Rice Univ., Houston, Tex. Dept. of Physics.
SOME CONSIDERATIONS ON MEASURING THE NEWTONIAN GRAVITATIONAL CONSTANT G IN AN ORBITING LABORATORY
Stephen D. Baker *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 17 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20C

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution.*

N87-16585 ESDU International Ltd., London (England).
COMPUTER-BASED ESTIMATION PROCEDURE FOR NEAR-FIELD SINGLE-STREAM JET NOISE
Dec. 1986 48 p
(ESDU-86034; ISBN-0-85679-586-0; ISSN-0307-0115) Avail: ESDU

A computerized method for estimating near-field exhaust noise spectra from a database is provided. The variables considered in the interpolation/extrapolation routine make the procedure particularly applicable to estimating noise from a single-stream jet. The database need not be restricted to data for an isolated single-stream jet but could include installation effects as well as other components of single-stream engine noise (e.g., combustion noise, shock noise, etc.). The method assumes that the jet is axisymmetric. The computation is carried out in two stages. First, a least-squares fitting procedure is used to estimate noise spectra, for the required jet operating conditions, at each of the nine database locations closest to the location of interest. A second fitting procedure, based on spatial distance, is then used to obtain the noise spectrum at the location of interest. Appropriate weighting is included at each computational stage. Noise data are output at one-third octave band levels, and an option is given to also output spectrum values in dB/Hz or (N/m sq.)/Hz. The computer program includes routines for writing data to the database and for editing the database. is given in the FORTRAN language. To provide a basic prediction procedure for near-field jet noise, a comprehensive database will be made available from ESDU. ESDU

N87-16586*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE GENERATED BY FLOW THROUGH LARGE BUTTERFLY VALVES
Ronald G. Huff Jan. 1987 17 p
(NASA-TM-88911; E-3336; NAS 1.15:88911) Avail: NTIS HC A01/MF A01 CSCL 20A

A large butterfly valve (1.37 m diam) was acoustically tested to measure the noise generated and propagating in both the upstream and downstream directions. The experimental investigation used wall mounted pressure transducers to measure the fluctuating component of the pipe static pressure upstream and downstream of the valve. Microphones upstream of the pipe inlet and located in a plenum were used to measure the noise radiated from the valve in the upstream direction. Comparison of the wall pressure downstream of the valve to a prediction were made. Reasonable agreement was obtained with the valve operating at a choked condition. The noise upstream of the valve is 30 dB less than that measured downstream. Author

N87-16587*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTUREBORNE NOISE CONTROL IN ADVANCED TURBOPROP AIRCRAFT
Irvin J. Loeffler Jan. 1987 24 p Presented at the 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987; sponsored by AIAA
(NASA-TM-88947; E-3362; NAS 1.15:88947; AIAA-87-0530) Avail: NTIS HC A02/MF A01 CSCL 20A

Structureborne noise is discussed as a contributor to propeller aircraft interior noise levels that are nonresponsive to the application of a generous amount of cabin sidewall acoustic treatment. High structureborne noise levels may jeopardize passenger acceptance of the fuel-efficient high-speed propeller transport aircraft designed for cruise at Mach 0.65 to 0.85. These single-rotation tractor and counter-rotation tractor and pusher propulsion systems will consume 15 to 30 percent less fuel than advanced turbofan systems. Structureborne noise detection methodologies and the importance of development of a structureborne noise sensor are discussed. A structureborne noise generation mechanism is described in which the periodic components or propeller swirl produce periodic torques and forces on downstream wings and airfoils that are propagated to the cabin interior as noise. Three concepts for controlling structureborne noise are presented: (1) a stator row swirl remover, (2) selection of a proper combination of blade numbers in the rotor/stator system of a single-rotation propeller, and the rotor/rotor system of a counter-rotation propeller, and (3) a tuned mechanical absorber. Author

N87-16588*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASURED NOISE OF A SCALE MODEL HIGH SPEED PROPELLER AT SIMULATED TAKEOFF/APPROACH CONDITIONS
Richard P. Woodward Jan. 1987 29 p Presented at the 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987; sponsored by AIAA
(NASA-TM-88920; E-3352; NAS 1.15:88920; AIAA-87-0526) Avail: NTIS HC A03/MF A01 CSCL 20A

A model high-speed advanced propeller, SR-7A, was tested in the NASA Lewis 9x15 foot anechoic wind tunnel at simulated takeoff/approach conditions of 0.2 Mach number. These tests were in support of the full-scale Propfan Text Assessment (PTA) flight program. Acoustic measurements were taken with fixed

microphone arrays and with an axially translating microphone probe. Limited aerodynamic measurements were also taken to establish the propeller operating conditions. Tests were conducted with the propeller alone and with three down-stream wing configurations. The propeller was run over a range of blade setting angles from 32.0 deg. to 43.6 deg., tip speeds from 183 to 290 m/sec (600 to 950 ft/sec), and angles of attack from -10 deg. to +15 deg. The propeller alone BPF tone noise was found to increase 10 dB in the flyover plane at 15 deg. propeller axis angle of attack. The installation of the straight wing at minimum spacing of 0.54 wing chord increased the tone noise 5 dB under the wing of 10 deg. propeller axis angle of attack, while a similarly spaced inboard upswept wing only increased the tone noise 2 dB. Author

N87-16589# Naval Underwater Systems Center, New London, Conn.
COMPARISON OF ACOUSTIC AND ELASTIC WAVE SCATTERING FROM ELLIPTICAL SHELLS
Ronald P. Radlinski and Murray M. Simon 3 Sep. 1985 18 p Presented at the 105th Meeting of the Acoustical Society of America, Cincinnati, Ohio, May 1983
(AD-A172984; NUSC-TD-7493) Avail: NTIS HC A02/MF A01 CSCL 20/1

An acoustic scattering formulation has been derived from a modification of the extended boundary integral method developed for elastic wave scattering from infinite cylindrical shells of arbitrary shape. The boundary condition of no tangential component of surface traction at the fluid-shell interface allows a simplification of the thin shell equations assumed to describe the motion of the scatterer. Expansion of the normal and tangential displacements of the shell into Fourier series which are a function of arc length reduces the shell equations to algebraic form. For this presentation the geometry is specialized to elliptical shells. Results are presented for shells of different materials and eccentricities. Comparisons are made between acoustic scattering and elastic p-p wave scattering. At low frequencies, modal resonances dominate the response of the shell in fluid. In an elastic medium, the modal response at the shell is reduced. At higher frequencies, creeping waves are generated for particular angles of incident. GRA

N87-16590# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
NOISE LEVELS FROM URBAN HELICOPTER OPERATIONS, NEW ORLEANS, LOUISIANA
Steven R. Albersheim Jun. 1986 40 p
(AD-A174129; FAA-EE-86-04) Avail: NTIS HC A03/MF A01 CSCL 20/1

The FAA conducted a noise monitoring program of helicopter operations at the Lakefront Airport in New Orleans, Louisiana. The purpose was to obtain noise measurements from helicopter operations in an urban environment. During this monitoring program the FAA concentrated solely on helicopter approaches to Lakefront Airport. The noise data was collected and classified as survey type data, since the monitoring program's measurements data obtained were from target of opportunity as opposed to a controlled test when the helicopter follow predefined flight path profiles. During the test period, ten different helicopter models were observed. Because of the high frequency of operations an opportunity was provided to determine the consistency between ALM values for the same helicopter model for different events. Since some of the monitoring sites were located in a residential community, an opportunity was provided to gather information on noise levels associated with a high frequency of helicopter operations. GRA

N87-16591# Los Alamos National Lab., N. Mex. Theoretical Div.
ACOUSTIC WAVE SCATTERING FROM A CIRCULAR CRACK: COMPARISON OF DIFFERENT COMPUTATIONAL METHODS
W. M. Visscher 1986 9 p Presented at the Conference on Review of Progress in Quantitative NDE, San Diego, Calif., 3 Aug. 1986
(Contract W-7405-eng-36)
(DE86-015311; LA-UR-86-2926; CONF-860856-4) Avail: NTIS HC A02/MF A01

The work reported was motivated by disagreement between the results obtained from two computations of scattering of an axially incident elastic p-wave on a circular crack. One calculation involves the direct solution of the Helmholtz integral equation, showing an oscillating total cross section. The other uses a program called MOOT, in which the elastic displacement near the crack is expanded in regular spherical eigenfunctions of the elastic wave equation. This calculation shows that the oscillations in total cross section disappear rapidly at high wave numbers. The conjecture that the basis for the MOOT expansion was inappropriate is examined by application to a test problem. Results indicate that there is no inadequacy in the spherical basis set. DOE

N87-16592# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
SPEED-OF-SOUND MEASUREMENTS IN NATURAL GAS FLUIDS Final Report, 1 Oct. 1984 - 31 Jan. 1986
A. Sivaraman and B. E. Gammon 31 Jan. 1986 24 p
(Contract GRI-5084-271-1026)
(PB87-115267; NIPER-B09000-B-029-10; GRI-86/0043) Avail: NTIS HC A02/MF A01 CSCL 20A

Experimental speed-of-sound data for pure methane are tabulated for temperatures from 193.05 to 423.15 K, for densities from 1 to 14.5 moles per cu. dm, and for pressures from 14 to 275.5 bar. The measurements were made at frequencies from 0.5 to 2.5 MHz. Corrections were made for viscous and thermal damping and for vibrational relaxation to provide equilibrium-thermodynamic values of the speed of sound at zero frequency. Equations of state, recently developed from PVT data, are capable of predicting the speed of sound to better than 0.1% in the range of temperature and pressure employed in metering and custody transfer of natural gases. The results show that these equations of state may be deficient for natural gases whose critical temperatures are significantly higher than that of methane. GRA

N87-16593# United Kingdom Atomic Energy Authority, Harwell (England). National NDT Centre.
AN INTRODUCTION TO ACOUSTIC EMISSION
C. B. Scruby Feb. 1986 29 p
(AERE-R-12139) Avail: NTIS HC A03/MF A01

Acoustic emission (AE) is clearly a potentially useful nondestructive test (NDT), process and materials probe. A number of characteristics that differentiate it from most established techniques and failure to recognize these has caused AE sometimes to be misused to give inevitably disappointing results. These major characteristics are summarized. The advantages of AE are discussed. Acoustic emission has already demonstrated its high sensitivity to deformation and fracture processes on a microscopic scale in the laboratory, and yielded insights into the dynamics of these processes. B.G.

N87-16583# Joint Publications Research Service, Arlington, Va.
ON POSSIBLE APPLICATIONS OF MOESSBAUER SPECTROSCOPY FOR THE DETERMINATION OF SOUND FIELD TOPOGRAMS IN LIQUIDS
A. R. Arakelyan, E. M. Arutyunyan, and M. M. Slavinskiy *In its* USSR report: Physics and Mathematics (JPRS-UPM-87-001 14 Jan. 1987 p 49-52 Transl. into ENGLISH from Izvestiya Akademii Nauk Armyanskoy SSR (Yerevan, USSR), v. 20, no. 5, Sep. - Oct. 1985 p 278-281 (For primary document see N87-16582 08-70)
Avail: NTIS HC A06/MF A01

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N87-16594# Florida State Univ., Tallahassee. Dept. of Physics.
RESEARCH IN ELEMENTARY PARTICLE PHYSICS Progress Report, 1 Aug. 1985 - 31 Jul. 1986

J. E. Lannutti 1986 56 p
(Contract DE-AS05-76ER-03509)
(DE86-014676; DOE/ER-03509/22) Avail: NTIS HC A04/MF A01

The experimental effort reported was divided between fixed target physics and preparation for future collider experiments. Experiments include di-hadron high p/sub t/ inclusive production, E/iota decay, work in preparation for the DO collider experiment (particularly building the central uranium calorimeter, software and electronics development, and beam testing and calibration), and generation of Monte Carlo events for the CERN ALEPH collider experiment. A theoretical program is also reported which includes the phenomenology of strong and electroweak interactions and Monte Carlo simulations of various field theories. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N87-16595# Pennsylvania State Univ., University Park. Dept. of Chemistry.
HIGH AND LOW ENERGY PARTICLE BEAMS INTERACTIONS WITH SOLIDS Final Report
Nicholas Winograd 1986 8 p
(Contract N00014-83-K-0052)
(AD-A172422) Avail: NTIS HC A02/MF A01 CSCL 20/12

The major goal of this research has been to establish a center for the preparation and surface characterization of advanced materials related to the construction of high speed electronic devices. The focal point of the experimental side of our center has been a molecular beam epitaxial (MBE) growth facility directly attached to a sophisticated surface analysis system. The growth facility has been initially set up to study the chemical aspects of interface formation during the fabrication of multilayer systems. The analysis chamber incorporates a number of novel approaches to characterizing the chemistry of these interfaces with unprecedented detail. These include LEED, XPS, angle resolved SIMS and Helium atom diffraction. On the theoretical side, our goal has been to establish extensive computational hardware and software for the modeling of the interaction of energetic particles with solids. This project has involved the development of interaction potentials which accurately predict forces between atoms in materials with directional bonding such as Gallium Arsenide and Silicon. GRA

N87-16596# Oak Ridge National Lab., Tenn. Div. of Health and Safety Research.
RESULTS OF THE RADIOLOGICAL SURVEY AT THE SPACE RADIATION EFFECTS LABORATORY, NEWPORT NEWS, VIRGINIA
M. G. Yalcintas Aug. 1986 30 p
(Contract DE-AC05-84OR-21400)
(DE86-015998; ORNL/TM-10064) Avail: NTIS HC A03/MF A01

The Space Radiation Effects Laboratory located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration (NASA). A synchrocyclotron was formerly in operation in this laboratory and a primary beam of 600 MeV protons and secondary beams of 400 MeV pions and muons were produced for the purpose of studying the effects of radiation on materials planned for use in space. The synchrocyclotron was removed in 1980. At several locations, the scattered radiation caused an induced radioactivity within the walls of the cyclotron room. A radiological survey has been performed to determine the amount of residual radioactivity on the walls. Calculations were performed to determine the thickness of the concrete walls and floor for shielding the residual radiation in the cyclotron room. Recommendations were made to minimize exposure to a potential occupant working in the cyclotron room. DOE

N87-16597# Lawrence Livermore National Lab., Calif.
PHYSICS OF ANTIMATTER-MATTER REACTIONS FOR !NTERSTELLAR PROPULSION
D. L. Morgan, Jr. 22 Aug. 1986 40 p Presented at the American Association for the Advancement of Science Annual Meeting, Philadelphia, Pa., 25 May 1986
(Contract W-7405-eng-48)
(DE86-016079; UCRL-95279; CONF-860588-1) Avail: NTIS HC A03/MF A01

At the stage of the antiproton-nucleon annihilation chain of events relevant to propulsion the annihilation produces energetic charged pions and gamma rays. If annihilation occurs in a complex nucleus, protons, neutrons, and other nuclear fragments are also produced. The charge, number, and energy of the annihilation products are such that annihilation rocket engine concepts involving relatively low specific impulse (I(sub sp) approx. = 1000 to 2000 s) and very high I(sub sp) (3 x 10 to the 7th power s) appear feasible and have efficiencies on the order of 50% for annihilation energy to propulsion energy conversion. At I(sub sp)'s of around 15,000 s, however, it may be that only the kinetic energy of the charged nuclear fragments can be utilized for propulsion in engines of ordinary size. An estimate of this kinetic energy was made from known pieces of experimental and theoretical information. Its value is about 10% of the annihilation energy. Control over the mean penetration depth of protons into matter prior to annihilation is necessary so that annihilation occurs in the proper region within the engine. Control is possible by varying the antiproton kinetic energy to obtain a suitable annihilation cross section. The annihilation cross section at low energies is on the order of or larger than atomic areas due to a rearrangement reaction, but it is very low at high energy where its value is closer to nuclear areas. DOE

74 OPTICS

N87-16598# Cornell Univ., Ithaca, N.Y. School of Applied and Engineering Physics.
WAVELENGTH INDEPENDENT OPTICAL LITHOGRAPHY Annual Report, 1 Sep. 1984 - 31 Aug. 1985
Aaron Lewis 6 Jun. 1986 81 p
(Grant AF-AFOSR-0314-84)
(AD-A171935; AFOSR-86-0558TR) Avail: NTIS HC A05/MF A01 CSCL 20/6

The transmission of light through an infinite slit in a thick, perfectly conducting screen is investigated. The spatial distribution of the near-field energy flux is determined through the formulation of four coupled integral equations, which are solved numerically. Transmission coefficients calculated by this method are in agreement with those determined by an alternative formulation. (Near-Field Scanning Optical Microscopy (NSOM)--A new method for high resolution imaging, near field scanning optical microscopy (NSOM), has been developed. The concepts governing this method are discussed, and the technical challenges encountered in constructing a working NSOM instrument are described. Two distinct methods are presented for the fabrication of well characterized, highly reproducible, sub-wavelength apertures.
Author (GRA)

N87-16599# Wisconsin Univ., Madison. Dept. of Physics.
EXPERIMENTAL RESEARCH ON OPTOGALVANIC EFFECTS Report, for 1 Aug. 1984 - 31 Jul. 1985
J. E. Lawler 5 Jun. 1986 5 p
(Grant AF-AFOSR-0298-84)
(AD-A171946; AFOSR-86-0518TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

Three pieces of capital equipment which were acquired under

this grant are briefly described. All are being used in ongoing experimental research on optogalvanic effects--changes in the conductance of a gas discharge caused by illumination with radiation at a wavelength corresponding to an atomic or molecular transition. We are studying these effects in order to produce a more quantitative understanding of discharges and of laser-discharge interactions. We expect that a better understanding of laser-discharge interactions will ultimately lead to the development of a laser controlled repetitive opening switch for pulsed power applications. The items purchased were: a Fizeau laser wavemeter, a double spectrometer, and highly regulated high voltage power supply. GRA

N87-16600# Pennsylvania State Univ., University Park. Dept. of Physics.
HOLE GRATINGS AND DIFFRACTION OF GAUSSIAN BEAMS Final Report, 1 Jul. 1983 - 31 Dec. 1984
T. A. Wiggins 15 Mar. 1986 13 p
(Grant AF-AFOSR-0258-83)
(AD-A172006; AFOSR-86-0641TR) Avail: NTIS HC A02/MF A01 CSCL 20/6

Methods for the determination of waist size and position for Gaussian beams are summarized and an alternative method which applies to pulse systems was proposed and tested. The general theory of Fraunhofer diffraction of Gaussian beams was developed which permitted a new method for location of laser waists. An extension to Fresnel diffraction was proposed. The use of hole gratings for production of multiple spots for damage threshold measurements is inherent to this work. The effects of their characteristics on the intensity profile are included. GRA

N87-16601# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
STUDIES OF OPTICAL WAVE FRONT CONJUGATION AND IMAGING PROPERTIES OF NEMATIC LIQUID CRYSTAL FILMS Annual Report, 15 Sep. 1984 - 14 Sep. 1985
Iam-Choon Khoo Jun. 1986 49 p
(Grant AF-AFOSR-0375-84)
(AD-A172089; AFOSR-86-0696TR) Avail: NTIS HC A03/MF A01 CSCL 20/6

Optical nonlinearities of liquid crystals owing to laser induced molecular reorientation or laser induced thermal index change, were studied in the context of optical wave mixings and real time imagings. The basic mechanisms and the dynamics of the nonlinearities were studied in details in theories, and in experiments using lasers of various time scales and temporal characteristics. Quantitative documentation of nanosecond laser induced thermal grating was performed for the first time, and further established the optical imaging and switching capabilities of nematic liquid crystal film. The conversion of infra-red images to visible images via real time optical wave mixing process was also demonstrated. The capability of optical four wave mixing to generate amplified reflection and self oscillation in nematic liquid crystal film was also demonstrated for the first time. Such a process will be useful for image processing as well as laser oscillator adaptive optics applications. In this period, new optical intensity switching effects using the transverse optical nonlinearity were also experimentally demonstrated, that will find applications in optical switching and power self limiting devices. GRA

N87-16602# Princeton Scientific Instruments, Kingston, N.J.
ULTRA VIOLET IMAGER SYSTEM Final Report, Aug. 1985 - Apr. 1986
John L. Lowrance 15 Apr. 1986 44 p
(Contract F19628-85-C-0118)
(AD-A172175; PSI-TM-8610; AFGL-TR-86-0113) Avail: NTIS HC A03/MF A01 CSCL 17/5

Princeton Scientific Instruments, Inc., has developed for the Air Force Geophysical Laboratory, AFGL, an Ultraviolet Imager to measure the spatial distribution of the UV radiation of missiles. An f/2.8, 200 mm focal length Cassigrain telescope optic is followed by a filter wheel containing 5 narrow band UV filters. The optical image is focused onto a 25 mm diameter micro channel plate (MCP) image intensifier having a solar blind Cs2Te photocathode. Photoelectrons from the photocathode are proximity focused onto the MCP and the MCP output electrons are proximity focused onto a P-20 phosphor. A 17 mm f/0.95 lens relays the d25 mm diameter phosphor image onto a CCD interline transfer type solid state image television camera. The television camera output is recorded by a video 3/4 inch magnetic tape cassette recorder and displayed on a 9 inch television monitor. The UV Imager exposure time can be varied by electronically shuttering the image intensifier from 1 ms to 33 ms, the television camera frame rate. Exposure times, filter wheel position and date are superimposed on the bottom of the video image. GRA

N87-16603 Department of the Air Force, Washington, D.C.
BEAM RECOMBINATION VIA CYLINDRICAL MIRROR Patent
Raymond C. Hedin, inventor (to Air Force), Samuel A. Meddaugh, inventor (to Air Force), and Ernest J. Torok, inventor (to Air Force) Issued 15 Jul. 1986 5 p Supersedes US-Patent-Appl-SN-603795
(AD-D012477; US-Patent-4,600,270; US-Patent-Appl-SN-603795; US-Patent-Class-350-162.17) Avail: US Patent and Trademark Office CSCL 20/6

A beam recombiner is used to parallelize two first order beams emanating from an magneto-optic stripe domain light deflector. One arrangement uses a concave cylindrical mirror with a negative meniscus lens attached thereon to redirect a conjugate beam. The other arrangement uses a concave cylindrical mirror with a cylindrical rod lens placed at the radius of curvature of the mirror to redirect the conjugate beam. GRA

N87-16604# Naval Sea Systems Command, Washington, D.C. Fiber Optics Program Office.
FIBER OPTICS
James H. Davis 4 Apr. 1986 17 p Presented at the 23rd Annual Technical Symposium, Washington, D.C., 1986
(AD-A173951) Avail: NTIS HC A02/MF A01 CSCL 20/6

Fiber optics is a rapidly developing technology that is being used in the design of ships and ship systems. This paper includes a brief overview of the history of fiber optics, the characteristics of optical fiber, the technology of fiber optics, and commercial applications for fiber optics. GRA

N87-16605# Battelle Columbus Labs., Ohio.
THE DESIGN OF RADIOGRAPHIC ENHANCEMENT SYSTEMS Final Report
Donald T. Hayford Sep. 1986 66 p
(Contract N00174-85-C-0055)
(AD-A174086; NAVEODTECHCE-TR-278) Avail: NTIS HC A04/MF A01 CSCL 14/5

Preliminary specifications and designs are given for two radiographic enhancement systems. The first system is a portable system designed to be carried with EOD teams to enhance the contrast of low density, low contrast radiographs made with existing EOD radiographic equipment. The second system contains both image enhancement and improved radiographic equipment and is designed to be carried aboard commercial or military aircraft in an airtransportable pod. Expected production costs and equipment selection are included. GRA

N87-16606# TRW Space Technology Labs., Redondo Beach, Calif. Applied Technology Div.
NONLINEAR OPTICS TECHNOLOGY. AREA 1: FWM (FOUR WAVE MIXING) TECHNOLOGY Final Report, Jun. 1985 - Jun. 1986
J. Brock, G. Holleman, F. Patterson, J. Fukumoto, and L. Frantz 22 Sep. 1986 153 p
(Contracts N00014-85-C-0257; DARPA Order 5369)
(AD-A174112) Avail: NTIS HC A08/MF A01 CSCL 17/2

Four wave mixing (FWM) performance in Na vapor was evaluated in the strong pumping regime (I much greater than Isat) required for typical applications related to point-to-point optical links. Gain (= reflectivity), imaging fidelity, and noise crosstalk were measured and analyzed under several conditions to obtain

an engineering data base for potential tactical applications such as communications, surveillance, and guidance systems. Results include greater than or = 230% reflectivity and 15 lines pair/mm imaging resolution, both the highest reported to date with CW pumping in low density Na vapor. The observed resolution was limited by the pixel spacing of the video camera. Ten 1p/mm resolution was obtained after passing the input image through a 65 lambda aberrator. Noise crosstalk was observable only when the combined signal/noise powers were large enough to saturate the phase conjugate return signal via pump depletion. Under these conditions, a degenerate, coherent noise beam 3x stronger than the signal beam produced only a 21% reduction in the intensity of the phase conjugate signal, and this degree of cross talk decreased rapidly as the pump/noise angle increased. GRA

N87-16607# Boeing Aerospace Co., Seattle, Wash.
MULTICHANNEL NEPHELOMETER Contractor Report, Sep. 1983 - Jun. 1986
Sterling Beck, Tim Majoch, and David Capps Oct. 1986 98 p
(Contract DAAK11-83-C-0089)
(AD-A174209; CRDEC-CR-87007) Avail: NTIS HC A05/MF A01 CSCL 07/4

A Multichannel Nephelometer has been designed and built. The instrument records the far-field light scattering pattern for individual aerosol particles in the size range 0.3-10.0 micrometers. The scattering pattern is sampled over a full 4 pi steradian solid angle. Incorporated in the Nephelometer is an aerosol handling system which can sample from a source with particle densities as high as 1000,000/cc, dilute this, and present one particle at a time to the light scattering chamber. The Nephelometer design, including the aerosol handling system, light scattering chamber, electronics and software is documented. GRA

N87-16608# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE NEAR-FIELD EFFECTS OF APODISATION ON COHERENT ABERRATED OPTICAL SYSTEMS M.S. Thesis
Daniel B. Allred Mar. 1986 92 p
(AD-A174236; AFIT/GNE/ENP/86M-1) Avail: NTIS HC A05/MF A01 CSCL 20/6

The effects of Gaussian apodisation with -0.8 waves of spherical aberration on a coherent optical system was examined. The area of study was in the near field concentrating on the areas near the focus in the Fresnel region of an f/12 system using optical wavelengths. Computer predictions were made for four cases: unapodised-unaberrated, apodised-unaberrated, unapodised-aberrated, and apodised-aberrated. Predictions were made for cross sectional planes perpendicular to the optical axis using Fourier optics. Merdional plane predictions were produced using a numerical integration method of determining the Kirchoff integral. Additionally, experimental data are given to compare with the predictions. It is shown that the experimental data matches the computer predictions and that apodisation is an effective method for controlling the ringing due to edge effects and spherical aberrations. Additionally, fine structure corresponding to Young's double slit interference is observed in unapodised cases. GRA

N87-16609# GTE Labs., Inc., Waltham, Mass.
HIGH SPEED LOW POWER NONLINEAR OPTICAL SIGNAL PROCESSING Final Technical Report, 26 May 1984 - 26 Jul. 1986
Mario Dagenais and Wayne F. Sharfin 15 Sep. 1986 107 p
(Contract F490620-84-C-0052)
(AD-A174492; AFOSR-86-1093TR) Avail: NTIS HC A06/MF A01 CSCL 20/6

During the two-year period of this contract, substantial progress was made in the understanding of both the linear and the nonlinear optical properties of direct gap semiconductors and in the implications for high speed, low power, nonlinear optical signal processing. In particular, the detuning and the temperature dependence of the damping of an exciton-polariton was obtained for the first time. The lowest single beam switching energy (less than 4 pJ) and the fastest reported ON/OFF switching (less than 1 ns) bistable device with clearly resolved stable states was demonstrated using the nonlinearity associated with bound excitons in CdS. Thermal effects on the millisecond and microsecond time scales were experimentally studied. Optical bistability due to induced absorption near the free and bound exciton was experimentally studied with and without a Fabry-Perot cavity. Large degenerate four-wave mixing signals were observed near free and bound excitons in CdS at cryogenic temperatures. Nonlinear transmission signals were studied at different detunings below the free exciton resonance and at temperatures up to 120 K. These signals were interpreted in terms of a broadening of the free exciton resonance by exciton-exciton collisions. The quantum confined stark shifting of a quantum dot was performed for the first time. A new generation of efficient optical modulators is envisioned. Author (GRA)

N87-16610# Air Force Weapons Lab., Kirtland AFB, N. Mex.
ON THE MODELING OF A LARGE-SCALE ELECTRO-OPTIC SYSTEM Final Report, Jan. 1985 - Apr. 1986
Stephen J. Walsh Jul. 1986 59 p
(AD-A174499; AFWL-TR-86-34) Avail: NTIS HC A04/MF A01 CSCL 20/6

Through this examination of a three-aperture bench laser experiment, a large-scale system realization model has been obtained. This realization model represents a valuable investigative tool for further control analysis and phased array experimental research. The experimental system was decomposed into five weakly coupled control loops that contained six components each. Transfer-function matrices for individual components were obtained through analysis of electrical schematics, experimental Bode plots, and through existing empirical data. The component models were cascaded together to form forward-loop transfer-function matrices for the five control loops. Closed-loop transfer-function matrices in observable canonical form were subsequently obtained. The modal matrices corresponding to three of the control loops were so poorly conditioned that a decoupled composite dynamical equation-based realization of high order was necessitated. GRA

N87-16611# Hughes Research Labs., Malibu, Calif.
OPTICAL FIBERS FOR NONLINEAR OPTICS Final Report, 1 Apr. 1985 - 15 Jul. 1986
S. C. Rand Oct. 1986 50 p
(Contract F49620-84-C-0043)
(AD-A174518; AFOSR-86-1096TR) Avail: NTIS HC A03/MF A01 CSCL 20/2

The main objective of this contract has been to find methods of fabricating single-crystal nonlinear optical fibers. Successful techniques were to be utilized to make crystal fibers useful for nonlinear optical devices, particularly devices exploiting second order optical nonlinearities. Device concepts and applications were also to be formulated. This work was initially divided into three parts. The first of these emphasized materials purification, characterization, and the measurement of physical and chemical properties of materials used in the fabrication of single-crystal and nonlinear fibers. The second task explored a variety of methods of production of single-crystal (SC) fibers, recognizing that one method can be applied, even in principle, to SC fiber growth of all materials of interest. The third task in this program involved the measurement of optical properties of the fabricated fibers and development of device applications. GRA

N87-16612# University of Southern California, Los Angeles.
OPTICAL SIGNAL PROCESSING USING NON-LINEAR OPTICS Annual Report, 1 Aug. 1984 - 30 Nov. 1985
William H. Steier Apr. 1986 10 p
(Grant AF-AFOSR-0207-84)
(AD-A174524; AFOSR-86-2011TR) Avail: NTIS HC A02/MF A01 CSCL 20/6

The 2-D correlation/convolution which can be achieved in real time via four wave mixing in nonlinear materials has been investigated in detail to determine the accuracy and signal power possible. This analysis was initiated under other support; the experimental confirmation was completed under this contract. The analysis which is based on Fourier transforms of the equations of

non-linear interaction has resulted in a closed form solution for the output and clearly shows how it differs from the desired 2-D correlation. In the example of a scene that is searched for given objects, the accuracy decreases as the ratio of scene to object size increases. Accuracy is also a result of a trade-off between size of scanned scene, and power or signal to noise ratio in the output. The analysis was confirmed experimentally in a colinear four wave interaction in the photorefractive material bismuth silicon oxide at 5145 A. The accuracy of the correlation between relatively simple patterns was measured and agreed well with the prediction of the analysis. GRA

N87-16613# Honeywell, Inc., Bloomington, Minn. Physical Sciences Center.
THIN-FILM OPTOELECTRONIC CIRCUITS RESEARCH PROGRAM Annual Technical Report, 1 Feb. 1985 - 30 Jun. 1986
Steven M. Arnold 25 Jul. 1986 45 p
(Contract F49620-85-C-0050)
(AD-A174572; AFOSR-86-1094TR) Avail: NTIS HC A03/MF A01 CSCL 20/6

Monolithic integration of electronic circuits in silicon has made possible a revolution in electronic computation and signal processing. Today, gallium arsenide integrated circuits (GaAs ICs) are extending this electronic revolution to ever higher speed devices. Optical signal processing, despite its consistent advances and several early successes such as synthetic aperture radar and the optical spectrum analyzer, is falling increasingly behind the electronic competition. Functions which formerly required the speed and parallelism of optics are now being implemented entirely in digital electronics. the reasons for this are several, but one in particular stands out: the lack of emphasis given to compatibility issues between optical and electronic IC fabrication processes. As a result, most integrated optic devices demonstrated to date have been discrete components requiring laborious interfacing to predominantly electronic systems. GRA

N87-16579# Joint Publications Research Service, Arlington, Va.
ACCOUNTING FOR QUANTUM NOISE IN ADAPTIVE FOCUSING OF OPTICAL RADIATION Abstract Only
V. A. Loginov and V. Ye. Antsiperov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 72-73 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1009-1016 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N87-16614*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
MEASUREMENTS OF PLASMA DENSITY AND TURBULENCE NEAR THE SHUTTLE ORBITER
A. Tribble, N. DAngelo, G. Murphy, and J. Pickett Jan. 1987 12 p
(Contract NAS8-32807; Grant NAG3-449)
(NASA-CR-180102; NAS 1.26:180102) Avail: NTIS HC A02/MF A01 CSCL 20I

In August 1985 the University of Iowa's Plasma Diagnostics Package was used in the Spacelab 2 mission to study the plasma environment near the shuttle orbiter. Measurements of the plasma density and the percentage density fluctuations yielded information about the structure of the orbiter's wake. These data appear to be in general agreement with previous shuttle results and with laboratory observations of plasma flow-body interactions. Author

N87-16615# Stanford Univ., Calif. High Temperature Gasdynamics Lab.
ADVANCED DIAGNOSTICS FOR REACTING FLOWS Annual Scientific Report, 1 Oct. 1984 - 30 Sep. 1985
R. K. Hanson 11 Oct. 1985 63 p
(Contract F49620-83-K-0004)
(AD-A171900; AFOSR-86-0633TR) Avail: NTIS HC A04/MF A01 CSCL 20/9

Progress is reported for the past year of an interdisciplinary program to innovate modern diagnostic techniques applicable to combustion and plasma flows. Research topics include: (1) digital flowfield imaging, including temporally and spatially resolved species and temperature imaging using planar laser induced fluorescence (PLIF); (2) quantitative particle imaging in spray flames using planar Mie scattering (PMS); (3) quantitative velocity and pressure imaging using variations of PLIF; (4) advanced solid state camera/computer systems for high speed and high resolution recording, processing and display of flow image data; (5) fiber optic absorption/fluorescence sensors employing tunable UV, visible and IR laser sources for species measurements; (6) laser wavelength modulation spectroscopy, using rapid-scanning UV, visible and IR laser sources, for absorption and fluorescence measurements of species, temperature and absorption lineshapes; (7) plasma diagnostics utilizing laser induced fluorescence and wavelength modulation techniques; (8) laser interactions with plasmas and combustion gases; and (9) investigation of other new diagnostic concepts. GRA

N87-16616# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
THE ROLE OF THE PLASMA DURING LASER-GAS LASER-METAL INTERACTIONS Annual Report, 11 Feb. 1985 - 30 Sep. 1986
Todd J. Rockstroh and Jyotirmoy Mazumder 13 Oct. 1986 193 p
(Grant AF-AFOSR-0041-83)
(AD-A174579; UILU-ENG-86-4011; AFOSR-86-1052TR) Avail: NTIS HC A09/MF A01 CSCL 20/5

The regime of CW laser-plasma-target interactions at intensities below 10 million W sq cm has been overlooked except for a few studies of gas assist configurations. The recent advances in industrial laser material processing and modeling efforts warrant a detailed study of laser-plasma-target interactions. The 10 KW CW CO2 laser facility has been used to study both pure gas and metal gas plasmas. Spectroscopic diagnostics have been applied to measure temperature in the plasma core where local electron temperatures are in excess of 10,000 K. GRA

N87-16580# Joint Publications Research Service, Arlington, Va.
STRUCTURE AND PROPERTIES OF OPTICAL-DISCHARGE PLASMA IN CO2-LASER BEAM NEAR TARGET SURFACE Abstract Only
Ye. V. Danshchikov, V. A. Dymshakov, F. V. Lebedev, and A. V. Ryazanov *In its* USSR Report: Physics and Mathematics (JPRS-UPM-86-007) 23 May 1986 p 91-92 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 12, no. 5, May 1985 p 1002-1008 (For primary document see N87-16568 08-70)
Avail: NTIS HC A07/MF A01

N87-16671 Leeds Univ. (England). Dept. of Applied Mathematics.
PLASMA JETS FROM ACTIVE GALACTIC NUCLEI
S. A. E. G. Falle *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 16-24 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16677 Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
ACCELERATION OF PARTICLES BY SHOCKS IN HIGH BETA PLASMAS
L. OC. Drury *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 93-98 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16682 Bulgarian Academy of Science, Sofia. Central Lab. for Space Research.
PLASMA DYNAMICS AND FIELD-ALIGNED CURRENT REVERSALS IN THE DAYSIDE OVAL
A. Z. Bochev, I. S. Arshinkov, and P. I. Nenovsky *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 185-188 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16689 Tokyo Univ. (Japan). Geophysics Research Lab.
INSTABILITIES AT PLASMA INTERFACES
Akira Miura *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 265-275 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16691 California Univ., Los Angeles. Dept. of Physics.
LABORATORY EXPERIMENT ON MAGNETIC RECONNECTION AND CURRENT DISRUPTIONS
R. L. Stenzel, W. Gekelman, and J. M. Urrutia *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 297-306 (For primary document see N87-16670 08-88)
(Contract AFOSR-F19628-85-K-0003; Grants NSF ATM-84-01322; NSF PHY-84-10495)
Avail: CEPADUES-Editions, Toulouse, France

N87-16694 Science Applications International Corp., McLean, Va.
DOUBLE LAYERS IN EXPERIMENTS, SIMULATIONS, AND SPACE
Robert A. Smith *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 327-350 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16695 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
NUMERICAL SIMULATIONS OF CURRENT DRIVEN DOUBLE LAYERS
G. Chanteur *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 351-355 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16697 Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THE AURORAL ALFVEN WAVE TURBULENCE AS A SOURCE OF THE PARTICLE ACCELERATION
A. S. Volokitin and E. M. Dubinin *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 371-375 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16703 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
LOW FREQUENCY ELECTROSTATIC TURBULENCE INDUCED BY ION CONICS IN PRESENCE OF COUNTERSTREAMING ELECTRONS
M. Malingre and R. Pottelette *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 415-422 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16716 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE PLASMA AND WAVE EXPERIMENT ON VEGA-1 AND VEGA-2
R. Grard, H. Arends, C. Beghin, J. Bouman, A. Butler, P. Fergeau, V. Formisano, J. Heida, K. Hjortnaes, J.-F. Karczewski et al *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 623-630 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16717 Sussex Univ., Brighton (England). School of Mathematical and Physical Sciences.
OBSERVATIONS OF PLASMA WAVES DETECTED AT THE UKS SPACECRAFT ASSOCIATED WITH AMPTE SOLAR WIND ION RELEASES
P. J. Christiansen, M. P. Gouch, A. J. Norris, A. G. Darbyshire, L. J. C. Woolliscroft, C. P. Chaloner, and D. S. Hall *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 631-639 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N87-16617# California Inst. of Tech., Pasadena.
THE INFLUENCE OF CONVECTION ON COMPONENT SEGREGATION IN THE BRIDGMAN-STOCKBARGER TECHNIQUE
Greg Neugebauer 15 Aug. 1986 79 p
Avail: NTIS HC A05/MF A01

The influence of operating parameters on convection in the Bridgman-Stockbarger technique of crystal growth was studied. The convective flow field was observed in a transparent Bridgman system. The organic compound salol was contained in a sample ampoule. Convection within the salol melt was visualized using sublimated sulfur as a tracer. The characteristics of the convection field were very sensitive to small variations in the thermal profile of the furnace. Convection was nearly nonexistent near the interface in the vertically stabilized thermal configuration. With the addition of a short booster heater between the main heater and the cooler, a destabilized temperature gradient was produced near the interface and significant convection was produced throughout the entire melt. Convective velocities increased as power to the booster furnace was increased. Convection was usually asymmetrical. Only under very carefully controlled conditions could a symmetrical flow field be produced.
Author

N87-16618# North Carolina State Univ., Raleigh. Dept. of Chemistry.
LOW TEMPERATURE GROWTH OF SILICON DIOXIDE FILMS: A STUDY OF CHEMICAL BONDING BY ELLIPSOMETRY AND INFRARED SPECTROSCOPY Interim Technical Report
G. Lucovsky, M. J. Manitini, J. K. Srivastava, and E. A. Irene 29 Jul. 1986 34 p
(Contract N00014-86-K-0305)
(AD-A171735; TR-8) Avail: NTIS HC A03/MF A01 CSCL 20/12

This paper presents a spectroscopic study using the techniques of ellipsometry and infrared (ir) absorption spectroscopy of the chemical bonding in silicon dioxide (SiO2) films grown in dry oxygen ambients at temperatures between 550 and 1000 C. We find that the index of refraction at 632.8 nm increases and the frequency of the dominant ir active bond-stretching vibration at about 1075/cm decreases as the growth temperature is decreased below 1000 C. Comparing the properties of these films with suboxides (SiOx, x <) grown by plasma enhanced chemical vapor deposition (PECVD), and compacted bulk silica has lead us to conclude; (1) that films grown at temperatures at or below 1000C are homogeneous stoichiometric oxides (SiO2); and (2) that the systematic and correlated variations in the index of refraction and the ir frequency result from increases in the film density with decreasing growth temperature. We present a microscopic model that accounts for; (1) the increases in the density and the index of refractions; and (2) the accompanying decrease in their stretching frequency in terms of a decrease in the Si-O-Si bond angle. GRA

N87-16619# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
TWO STEP OXIDATION PROCESSES IN SILICON
N. M. Ravindra, Dariush Fathy, J. Narayan, J. K. Srivastava, and E. A. Irene 29 Jul. 1986 17 p
(Contract N00014-86-K-0305)
(AD-A171741; TR-10) Avail: NTIS HC A02/MF A01 CSCL 20/12

We have studied dielectric breakdown characteristics of this (approx. 10nm) silicon dioxide films grown on silicon under the following conditions: (A) Standard oxidation process with the oxides grown at 800C; (B) Annealing the oxides at 1000C in argon for 30 minutes after going through step (A); (C) Two - Step oxidation, i.e., 800C - 4 nm followed by 1000C anneal for 30 minutes in argon and a final oxidation, at 8000C to grow a total of 9 nm; (D) Growth of oxide at 1000C. The results show that (B) and (C) have comparable dielectric breakdown strengths, indicating that high temperature annealing has the same advantage as the two-step oxidation in improving the dielectric strength of silicon dioxide. High resolution transmission electron micrographs show that the interface structures are fairly similar in all the cases indicating that the interface smoothness as observed in the transmission electron micrographs are not directly responsible for the dielectric breakdown. Our observations of the protrusions at the Si/SiO2 interface may also possibly explain the high values of the refractive index which has earlier been attributed to a monolayer of nonstoichiometric SIOX at the SI/SIO2 interface. GRA

N87-16620# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
SILICON OXIDATION AND SiO2 INTERFACE OF THIN OXIDES Interim Technical Report
N. M. Ravindra, J. Narayan, Dariush Fathy, J. K. Srivastava, and E. A. Irene 29 Jul. 1986 18 p
(Contract N00014-86-K-0305)
(AD-A171796; TR-9) Avail: NTIS HC A02/MF A01 CSCL 20/12

High Resolution Transmission Electron Microscopy (HRTEM) and ellipsometry techniques have been employed to measure thicknesses of silicon oxide, grown at 800 C in dry oxygen, in the thickness range of 2 to 20 nm. While the oxide growth data measured from TEM obey a linear behavior, those obtained from ellipsometry are seen to follow a linear-parabolic law. The interface structure as function of the increasing oxide thickness was studied using HRTEM. At these oxidation temperatures, we do not see the earlier reported systematic dependence of roughness at the interface on the oxide thickness for oxides grown at 900 C. Attempts aimed at correlating the high resolution transmission electron micrographs with some physical parameters like the refractive index and the dielectric breakdown lead us to considerations of the importance of the effect of protrusions of silicon atoms of 1nm size into SiO2 layers on the interface properties. These findings lead us to explain some key features concerning the refractive index, density and dielectric strength of thin SiO2. GRA

N87-16621# EPI-Tech Corp., Paradise Valley, Ariz.
GROWTH OF GALLIUM ARSENIDE USING ION CLUSTER BEAM TECHNOLOGY Final Report, Sep. 1983 - May 1984
Robert L. Adams Aug. 1986 51 p
(Contract F33615-83-C-1113)
(AD-A171801; AFWAL-TR-86-1057) Avail: NTIS HC A04/MF A01 CSCL 20/12

The growth of single crystal gallium arsenide (GaAs) epitaxial films on high resistivity GaAs substrates has been demonstrated. Films were grown at substrate temperatures from 600C down to 400C with thicknesses from 3000A to 5 micron. Growth rates were typically 150A/minute at all growth temperatures with thickness uniformity of + or - 5% over the sample (typical sample size 0.7in. X 0.7in.). The thickness was measured by a standard cleave and stain method. Single crystal behavior was shown using X-ray diffraction and SEM channeling patterns. Auger analysis was done on the films and showed characteristics comparable to those of the substrate. Hall data taken on the samples found the samples to be n-type, but with very low mobility. The low mobility is the result of defects grown into the structure because of high energy ions impinging on the surface. The energy of the ions was in the range of 100 to 1000 ev because of the small cluster size. The cluster had sizes of 10-50 atoms instead of the desired 500-2000 atoms/cluster. This smaller cluster is likely due to non-uniform heating of the crucibles by the e-beam filament. In addition, the diameter/length of the opening in the nozzle was 1:1. Recent work suggests a 1:10 ratio will allow more interactions and thus enhance the possibility of forming larger clusters. With larger clusters, lower energy per ion will be possible and the native defects will be reduced. GRA

N87-16622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTION OF THE CHANGE IN THERMAL CONDUCTIVITY OF SEMICONDUCTORS IN A MAGNETIC FIELD
Kh. I. Amirkhanov, A. Z. Daibov, and V. P. Zhuze 5 Sep. 1986 12 p Transl. into ENGLISH from Doklady Akademii Nauk SSSR (USSR), v. 98, no. 4, 1954 p 557-560
(AD-A171890; FTD-ID(RS)T-0831-86) Avail: NTIS HC A02/MF A01 CSCL 20/12

The Maggi-Righi-Leduc effect consists in the appearance of an additional longitudinal difference in temperatures delta T in the plate of a conductor placed in a transverse magnetic field H perpendicular if there is a temperature gradient along the plate. The appearance of this difference in temperature leads to an increase in the effective part of thermal conductivity. GRA

N87-16623# SRI International Corp., Menlo Park, Calif.
SEMICONDUCTOR ENGINEERING FOR HIGH-SPEED DEVICES Quarterly Report, 1 Jan. - 31 Mar. 1986
A. Sher, S. Krishnamurthy, and A. B. Chen 16 Mar. 1986 6 p
(Contracts F49620-85-C-0103; ARPA Order 5396; AF Proj. 0053)
(AD-A172053; AFOSR-86-0799TR; QR-3) Avail: NTIS HC A02/MF A01 CSCL 20/12

This report summarizes accomplishments during the 3rd Quarterly reporting period. Our aim has been to improve the accuracy of the model described in the previous report and to predict v-E behavior in various alloys. The two valley-single electron temperature model was further generalized to calculate v-E characteristics without assuming a constant energy relaxation time. As the electric field is increased, the average energy of electrons increases. Electrons lose some energy to the lattice. The rate of energy loss is calculated by assuming that energy transfer takes place only through longitudinal optical phonons. Based on our preliminary calculations, we conclude that alloys with constituent materials that exhibit an indirect gap are not suited for high speed devices. However, there are some interesting features to their behavior, e.g., a large negative temperature coefficient of the mobility which could prove to be useful in temperature sensors. GRA

N87-16624# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SINGLE CRYSTAL FILMS OF SEMICONDUCTORS ON AMORPHOUS SUBSTRATES VIA A LOW TEMPERATURE GRAPHOEPITAXY Annual Technical Report, 1 Mar. 1985 - 28 Feb 1986
Harry I. Smith Apr. 1986 18 p
(Grant AF-AFOSR-0154-85)
(AD-A172057; AFOSR-86-0751TR) Avail: NTIS HC A02/MF A01 CSCL 20/12

The objective of this program is to carry out basic research in order to acquire fundamental understanding which will permit the development of a general, low temperature process for obtaining oriented, defect free single crystal semiconductor films on amorphous substrates. Surface energy driven grain growth was investigated as a means of achieving device quality semiconductor films on amorphous substrates. The time, temperature, and film thickness dependence of grain growth was measured for Si and Ge, and the effects of P, As, and B doping in Si were studied. GRA

N87-16625# SRI International Corp., Menlo Park, Calif.
SEMICONDUCTOR ENGINEERING FOR HIGH-SPEED DEVICES Quarterly Status Report, 1 Jun. - 15 Sep. 1985
A. Sher, S. Krishnamurthy, and A. B. Chen 18 Sep. 1985 5 p
(Contracts F49620-85-C-0103; ARPA Order 5396; AF Proj. 0053)
(AD-A172092; AFOSR-86-0797TR; QSR-1) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report contains a summary of significant accomplishments and progress during the reporting period. Programs to calculate pure crystal and alloy band structures have been completed and now include all important components, e.g., long-range interactions, spin-orbit interactions, and molecular CPA. The parameters that properly reproduce the band structures of light III-V compounds--GaP, InP, AlAs, GaAs, InAs, AlSb, GaSb, and InSb--have been selected and their band structures calculated. We are now prepared to run the band structures of the 14 three--component pseudo-binary alloys of these materials. These calculations were undertaken to test our procedures on a comparatively simple, well-characterized alloys system. The results agree with experiment and give satisfactory explanation of several features that were previously thought to be anomalous. It is clear that the general trends of the data and theory agree. GRA

N87-16626# SRI International Corp., Menlo Park, Calif.
SEMICONDUCTOR ENGINEERING FOR HIGH-SPEED DEVICES Quarterly Report, 1 Oct. - 31 Dec. 1985
A. Sher, S. Krishnamurthy, and A. B. Chen 15 Dec. 1985 8 p
(Contract F49620-85-C-0103; ARPA Order 5396; Contract DA Proj. 005-3)
(AD-A172194; AFOSR-86-0798TR; QR-2) Avail: NTIS HC A02/MF A01 CSCL 20/12

Our aim in this period has been to devise a simple, physically intuitive model to study the quantitative trends of hot-electron behavior in semiconductor alloys. This is being done to offer preliminary guidance to experimental programs, and to serve as a simple limit to check the more elaborate calculations still to come. Even our simple model is based on fairly complete alloy band structures, and therefore constitutes an advance over previously published results. Author (GRA)

N87-16627 Department of the Air Force, Washington, D.C.
X33 CUT QUARTZ FOR TEMPERATURE COMPENSATED SAW (SURFACE ACOUSTIC WAVE) DEVICES Patent
Richard T. Webster, inventor (to Air Force) Issued 22 Jul. 1986 6 p Supersedes US-Patent-Appl-SN-614190
(AD-D012491; US-Patent-4,602,182; US-Patent-Appl-SN-614190; US-Patent-Class-310-313) Avail: US Patent and Trademark Office CSCL 20/2

An X-cut, 33.44 degree quartz crystal for propagating surface acoustic waves with a temperature stability in the order of -0.0209 ppm/sq.cm. is described. The crystal orientation requires only a single rotation (33.44 degrees) from the crystal axes. This orientation is substantially simpler than previously reported cuts with comparable temperature stability which typically require three rotations. The X-cut orientation has a surface acoustic wave (SAW) velocity of 3175 m/sec, an electromechanical coupling of 0.0004, and a power flow angle of 2.7 degrees. Author (GRA)

N87-16628# Illinois Univ., Urbana. Coordinated Science Lab.
SEMICONDUCTOR HETEROSTRUCTURES AND NEW FORMS OF DEVICES Final Progress Report, 1 Oct. 1983 - 31 Aug. 1986
K. Hess Sep. 1986 18 p
(Contract DAAG29-84-K-0001)
(AD-A172731; ARO-20616.14-EL; FPR-7) Avail: NTIS HC A02/MF A01 CSCL 20/12

The ultimate limitations of electronic transport in semiconductor heterostructure layers and superlattices are investigated. The potential of these layers for novel semiconductor device applications is assessed. Author (GRA)

N87-16629# Massachusetts Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Aug. - 31 Oct. 1985
Alan L. McWhorter 15 Nov. 1985 116 p
(Contract F19628-85-C-0002)
(AD-A172872; Rept-1985-4; ESD-TR-85-302) Avail: NTIS HC A06/MF A01 CSCL 09/3

This report covers in detail the solid state research of the Solid State Division. The topics discussed are divided into these areas Solid State Device Research; Quantum electronics; Materials research; Microelectronics; and Analog Device Technology. GRA

N87-16630# University of Southern California, Los Angeles.
APPARATUS FOR ANALYSIS OF EPITAXIAL CRYSTAL GROWTH Final Report, 1 Aug. 1983 - 1 Oct. 1984
P. D. Dapkus 8 Jul. 1986 7 p
(Grant AF-AFOSR-0277-83)
(AD-A172890; AFOSR-86-0917TR) Avail: NTIS HC A02/MF A01 CSCL 20/12

An epitaxial growth and analysis apparatus is used to investigate the chemistry, photochemistry, and kinetics of growth of semiconductor thin films by metalorganic chemical vapor deposition (MOCVD). The apparatus consists of an epitaxial growth chamber compatible with the inclusion of in situ diagnostic techniques, an excimer dye laser system for use in laser induced fluorescence (LIF) studies of gaseous species, and a mass spectrometer for in situ analysis of gaseous constituents of MOCVD growth environment. These items were to be incorporated into a system for the investigation of the growth kinetics of MOCVD. GRA

N87-16631# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE EFFECT OF IONIZING RADIATION ON THE BREAKDOWN VOLTAGE OF POWER MOSFETS M.S. Thesis
Robert D. Pugh 1986 90 p
(AD-A172914; AFIT/CI/NR-86-182T) Avail: NTIS HC A05/MF A01 CSCL 09/1

Vertical double-diffused (VD) metal oxide semiconductor (MOS) field effect transistor (FET), or VD MOSFET, describes the structure and operation of a very useful solid state device. Developed in the early 1980s, VD MOSFETs (also called power MOSFETs) have become widely used in the electronic industry due to their ability to switch large currents at high frequencies (10-100kHz) and because of their thermal ruggedness. VD MOSFETs are particularly useful in both space and military applications because they allow engineers to design power supplies that work at high frequencies; with higher power supply frequencies the size of the transformers, and therefore the weight of the systems, can be reduced significantly. Space-based systems operate in a cosmic radiation environment, and military radiation-hardness specifications must be satisfied; therefore, the effect of radiation on the operating characteristics of devices to be used in either application must be well known. The MOSFET structure is resistant to neutron damage at normally encounteredt fluences; however, they are sensitive to gamma radiation. Designers are primarily interested in knowing the effect of gamma radiation on the threshold voltage (VTH) and breakdown voltage (VBD) of MOSFETs. These two parameters are very important because, if they change, the behavior of a MOSFET in a circuit can change drastically. GRA

N87-16632# Naval Postgraduate School, Monterey, Calif.
EFFECTS OF 30 MEV ELECTRON IRRADIATION ON InGaAsP LEDs (LIGHT EMITTING DIODES) AND InGaAs PHOTODIODES M.S. Thesis
Patrick J. OReilly Jun. 1986 191 p
(AD-A173617) Avail: NTIS HC A09/MF A01 CSCL 20/12

InGaAsP LEDs and InGaAs photodiodes were irradiated with a 30 MEV electron beam. The rate of performance degradation were studied. Simple models for LED and photodiode current controlling mechanisms and for a phenomenological radiation damage constant are presented. The dominant current controlling mechanisms and the peak wavelength of the LEDs and photodiodes did not change during irradiation. GRA

N87-16633# Dayton Univ., Ohio. Research Inst.
ANALYSIS OF IMPURITY BAND FORMATION AND RELATED EFFECTS NEAR THE P/N JUNCTION IN COMPENSATED GaAs AND Si Final Report, Jul. 1985 - Mar. 1986
L. C. Brown Sep. 1986 294 p
(Contract F33615-81-C-2012)
(AD-A173727; AFWAL-TR-86-2032) Avail: NTIS HC A13/MF A01 CSCL 20/14

This report contains the results of applying the bandgap narrowing model to studying the dopant concentration changes near the P/N junction of semiconductor parameters that have a direct effect on current voltage characteristics. The report describes the method of compute modeling and analysis and the important conclusions reached. Of significance is the explanation of compensated semiconductor material behavior vs temperature and its implication for solar cells and microwave detectors. GRA

N87-16634# State Univ. of New York, Buffalo. Dept. of Physics.
STUDIES OF ELECTRONIC AND OPTOELECTRONIC PROPERTIES OF SUPERLATTICES Annual Report, 1 Oct. 1985 - 30 Sep. 1986
Akira Isihara 29 Sep. 1986 5 p
(Contract N00014-84-K-0387)
(AD-A173939) Avail: NTIS HC A02/MF A01 CSCL 20/3

Contract year research accomplishments are summarized and publications are listed. The following subjects are addressed: fractional quantized Hall effect; integral quantized Hall effect; magnetoconductivity; sound propagation in He films; and size quantization effect. GRA

N87-16635# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.
LASER DRIVEN PROCESSES AT GaAs SURFACES Final Report, Jul. 1983 - Jun. 1986
Kenneth C. Janda 30 Oct. 1986 9 p
(Contract N00014-83-K-0506)
(AD-A174079; FR-8) Avail: NTIS HC A02/MF A01 CSCL 20/12

This is the final report of a project entitled Laser Driven Processes at GaAs Surfaces performed at the California Institute of Technology. Six publications dealing with energy transfer at the gas-surface interface have resulted from this project. GRA

N87-16636# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering.
LOW-ELECTRONEGATIVITY OVERLAYERS AND ENHANCED SEMICONDUCTOR OXIDATION: Sm ON Si(111) AND GaAs(110) SURFACES Interim Report, 1 Aug. 1984 - 30 Jul. 1986
A. Franciosi, S. Chang, P. Philip, A. Wall, and A. Raisanen 15 Apr. 1986 18 p
(Contract N00014-84-K-0545)
(AD-A174109; TR-8) Avail: NTIS HC A02/MF A01 CSCL 07/4

Thin mixed valence overlayers (less than 1 monolayer) of Sm deposited on Si or GaAs cleavage surfaces prior to oxygen exposure give rise to oxidation promotion effects of unprecedented magnitude. In contrast with this, purely divalent Sm overlayers (thickness less than 1 monolayer) exhibit negligible oxidation promotion activity. The roles of metal electronegativity and metal-semiconductor interface morphology are examined in determining the specific catalytic activity of the overlayer. GRA

N87-16637# Missouri Univ., St. Louis. Dept. of Physics.
FUNDAMENTAL QUANTUM 1/F NOISE IN ULTRASMALL SEMI CONDUCTOR DEVICES AND THEIR OPTIMAL DESIGN PRINCIPLES Annual Report, 1 May 1985 - 30 Apr. 1986
Peter H. Handel May 1986 40 p
(Grant AF-AFOSR-0130-85)
(AD-A174512; AFOSR-86-2012TR; AR-1) Avail: NTIS HC A03/MF A01 CSCL 09/3

A second-quantized derivation of the quantum (1/f) effect was developed. This derivation is based on the pair correlation function and automatically includes the right form of exchange between fermions and between bosons. Also for the first time a direct calculation of the effect of a finite mean free path was performed. This calculation justifies the calculation of quantum (1/f) noise and results in a correction factor of the order of the unity. As a first step of a more general study of (1/f) in semiconductor devices (n+-p) diodes have been investigated with emphasis on (HgCdTe) photodetectors. Quantum (1/f) noise has been calculated in the surface and bulk recombination currents, in the diffusion and field currents, and in the tunneling currents. Due to the large localized electric field at the surface, a larger fractional quantum (1/f) noise power is obtained for surface recombination currents than for similar bulk recombination currents. All quantum (1/f) noise calculations are first principles calculations with no free parameters, based on the quantum (1/f) effect in scattering and recombination cross sections, as well as in tunneling rates. GRA

N87-16638# California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.
DEVELOPMENT OF A PLANAR HETEROJUNCTION BIOPOLAR TRANSISTOR FOR VERY HIGH SPEED LOGIC Interim Report, 1 Mar. - 29 Jun. 1986
Stephen I. Long, Herbert Kroemer, and M. A. Rao 30 Oct. 1986 18 p
(Grant AF-AFOSR-0344-82)
(AD-A174580; AFOSR-86-2009TR) Avail: NTIS HC A02/MF A01 CSCL 20/12

Graded regions of n-(Ga,In)As and p-Ga(As,Sb) were incorporated side-by-side as emitter and base contacts, respectively, into an npn (Al,Ga)As/GaAs heterostructure bipolar transistor (HBT). The process involved two separate MBE growths, leading to base contact regions that were self-aligned to the emitter mesas. The devices could be easily probed with pressure contacts even prior to any metallization, and excellent characteristics were obtained after final metallization. GRA

N87-16639# Michigan Univ., Ann Arbor. Dept. of Physics.
GROWTH AND DYNAMICS OF SCALE INVARIANT MATTER Progress Report
R. Savit and L. M. Sander Aug. 1986 19 p
(Contract DE-FG02-85ER-45189)
(DE86-014478; DOE/ER-45189/1) Avail: NTIS HC A02/MF A01

Research concentrates on the growth of crystals. Solutions are sought for problems in growth velocity and the modeling of nonequilibrium and disorderly irreversible growth. A list of publications resulting from this work is included. DOE

N87-16640# Los Alamos National Lab., N. Mex. Applied Theoretical Physics Div.
HIGH SPATIAL RESOLUTION IN X-RAY FLUORESCENCE
J. D. Zahrt 1986 14 p Presented at the Denver X-ray Conference, Denver, Colo., 4 Aug. 1986
(Contract W-7405-eng-36)
(DE86-013820; LA-UR-86-2637; CONF-860891-1) Avail: NTIS HC A02/MF A01

The design of diffracting crystals for use in X-ray fluorescence spectrometers is discussed. Characteristics of the Johan and Johansson geometries are discussed and intensity profiles are developed. If the diffraction line has a finite width, concentration gradients will not be faithfully reproduced by gradients in the signal as the sample is scanned. Boundary effects for four types of concentration gradient are presented; as step function, linear gradients, exponential gradient, and Gaussian gradient. DOE

N87-16641# Bell Communications Research, Inc., Murray Hill, N.J.
Pd/SUB x/GaAs/GaAs: CORRELATION BETWEEN INTERFACE STRUCTURE, MORPHOLOGY AND ELECTRICAL PROPERTIES
T. Sands, K. M. Yu, S. K. Cheung, and V. G. Keramidas May 1986 14 p Presented at the Northeast Regional Meeting on Semiconductor-based Heterostructure Interfacial Structure and Stability, Murray Hill, N.J., 1 May 1986 Prepared in cooperation with California Univ., Lawrence Berkeley Lab., Berkeley, Calif.
(Contract DE-AC03-76SF-00098)
(DE86-015198; LBL-21049; CONF-8605111-4) Avail: NTIS

HC A02/MF A01

The structure, morphology, comosition and electrical properties of ternary phase (Pd/sub x/GaAs) films on GaAs have been studied by transmission electron microscopy, energy dispersive x-ray spectrometry, Rutherford backscattering spectrometry and current-voltage measurements. Annealing 15 nm of Pd on (100) GaAs at 250°C yields a planar monocrystalline film of the first ternary phase (approx.Pd/sub 3.9/Ga/sub 1.1/As/sub 0.9/) which is a rectifying contact to n-GaAs with a barrier height of approx. 0.76 eV. A subsequent annealing treatment at 350°C converts the film to a second ternary phase (approx. Pd/sub 3.3/Ga/sub 1.2/As/sub 0.8/) that exhibits a rough interface with GaAs, severely degraded electrical properties and a lower barrier height. The reduction in the measured barrier height is attributed to thermionic-field emission at sharp corners and protrusions in the Pd/sub x/GaAs/GaAs interface. The implications of these results for the utilization of Pd in multielemental contacts to GaAs are also discussed. DOE

N87-16642# Oak Ridge National Lab., Tenn. Solid State Div.
EXCIMER LASER PROCESSING OF SEMICONDUCTOR DEVICES: HIGH-EFFICIENCY SOLAR CELLS
R. F. Wood Sep. 1986 10 p Presented at the SPIE Fiber LASE 86, Cambridge, Mass., 14 Sep. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000378; CONF-8609127-8) Avail: NTIS HC A02/MF A01

Over the past decade, laser processing of semiconductors has developed into an area of widespread interest in solid state physics, materials science, and semiconductor device technology. Initially, most of the work on pulsed laser processing was performed with solid state lasers such as ruby and Nd:YAG lasers. These lasers have several inherent characteristics that make them less than ideal for studies of laser processing and that would seemingly prohibit their use in many commercial applications. More recently, results which demonstrate that ultraviolet excimer lasers offer many desirable characteristics for the laser processing of materials, were reported in the literature. Solar cells are relatively simple semiconductor devices that are of considerable interest in their own right and provide a useful testing ground for the application of laser techniques to semiconductor processing. In this paper, some important aspects of pulsed laser processing of semiconductors are reviewed, the advantages of excimer lasers for such work are assessed, the present status of laser processing of high-efficiency solar cells is discussed, and finally the possible future directions of this type of work are briefly mentioned. DOE

N87-16643# California Univ., Berkeley. Lawrence Berkeley Lab.
INTRINSIC LINEWIDTHS OF 1S(YIELD)nP DONAR TRANSITIONS IN ULTRA-PURE GERMANIUM
E. E. Haller, H. Navarro, and F. Keilmann (Max-Planck-Inst. fuer Festkoerperforschung, Stuttgart (West Germany).) Jul. 1986 7 p Presented at the 18th International Conference on Physics of Semiconductors, Stockholm, Sweden, 11 Aug., 1986
(Contract DE-AC03-76SF-00098)
(DE87-000929; LBL-22120; CONF-860892-4) Avail: NTIS HC A02/MF A01

The Full Widths at Half Maximum (FWHM) measured for the observed transitions of the D(H,O) donor are of the order of 8.5 micro eV or smaller. The FWHM observed can be attributed to lifetime broadening produced by the permanence time (tau is approximately (pi Lambda omega)(sup -1)) = .16 ns) of the carrier in a bound excited state. This time is limited by recombination to the ground state through emission of acoustic phonons. DOE

N87-16644# National Bureau of Standards, Gaithersburg, Md. Semiconductor Electronics Div.
SEMICONDUCTOR MEASUREMENT TECHNOLOGY: A BIBLIOGRAPHY OF NBS (NATIONAL BUREAU OF STANDARDS) PUBLICATIONS FOR THE YEARS 1962-1985
J. Walters Oct. 1986 107 p
(PB87-112298; NBSIR-86-3464) Avail: NTIS HC A06/MF A01 CSCL 20L

The bibliography contains reports of work performed at the National Bureau of Standards in the field of Semiconductor Measurement Technology in the period from 1962 through December 1985. GRA

N87-16645# National Bureau of Standards, Boulder, Colo. Electromagnetic Technology Div.
ELECTROMECHANICAL PROPERTIES OF SUPERCONDUCTORS FOR DOE (DEPARTMENT OF ENERGY) FUSION APPLICATIONS
J. W. Ekin, J. Moreland, and J. C. Brauch Mar. 1986 112 p Sponsored by DOE
(PB87-125753; NBSIR-86/3044) Avail: NTIS HC A06/MF A01 CSCL 20L

A report on the Electromechanical Properties of Superconductors in fusion applications contains the following: Uniaxial strain-effect characterization of new high-field experimental superconductors; High-field uniaxial strain effect characterization of candidate Nb3Sn superconductors for fusion applications-Internal tin, jelly roll, bronze process; Construction and initial testing of a transverse stress-effect apparatus; Thermal contraction of several candidate sheathing and strengthening materials for superconductors; Electron tunneling into superconducting filaments using mechanically adjustable barriers; Appendix A-Effect of stainless steel reinforcement on the critical current versus strain characteristics of multifilamentary Nb3Sn superconductors; Appendix B-Further investigations of the solid-liquid reaction and high-field critical current density in liquid-infiltrated Nb-Sn superconductors; and Appendix C: Japan trip report, December 5 to 14, 1984. GRA

N87-16175# Joint Publications Research Service, Arlington, Va.
LARGE-AREA CdTe/Al(SUB)2O(SUB)3 EPITAXIAL FILMS
E. A. Senokosev, K. D. Sushkevich, A. N. Usatyy, and V. M. Federov *In its* USSR Report: Engineering and Equipment 13 Aug. 1986 p 64-67 Transl. into ENGLISH from Izvestiya Akademii Nauk Moldavskoy SSR: Seriya Fiziko-Tekhnicheskikh i Matematicheskikh Nauk (Kishinev, USSR), no. 3, Sep. - Dec. 1985 p 67-69 (For primary document see N87-16171 08-31)
Avail: NTIS HC A04/MF A01

N87-16584# Joint Publications Research Service, Arlington, Va.
EXOTIC SUPERCONDUCTORS
Aleksandr Ivanovich Buzdin and Viktor Vasilyevich Moshchalkov *In its* USSR report: Physics and Mathematics (JPRS-UPM-87-001) 14 Jan. 1987 p 59-80 Transl. into ENGLISH from Novoye v Zhizni, Nauke, Technike: Seriya Fizika (Moscow, USSR), no. 5, May 1986 p 100-101 (For primary document see N87-16582 08-70)
Avail: NTIS HC A06/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N87-16646 Texas Univ., Austin.
TOPICS IN SUPERGRAVITY AND SUPERSTRING PHENOMENOLOGY Ph.D. Thesis
Fernando Quevedo-Rodriguez 1986 92 p
Avail: Univ. Microfilms Order No. DA8618568

Different aspects of supergravity and superstring phenomenology are discussed. First a detailed analysis is made of a broad class of O'Raifeartaigh models coupled to N = 1 supergravity with supersymmetry broken at an intermediate scale. These models can be considered either as an extension of the so called hidden sector models, or as an extension of previously proposed globally supersymmetric models to include the effects of gravity. The effective low-energy potential is derived. The stability of the mass hierarchy in the absence of light singlets is demonstrated at the tree level and one-loop order. The process of spontaneous

compactification is discussed next and it is applied to two different theories. First, gauged N = 2D = 7 supergravity is considered. A Chern-Simmons term is found in order to make the original theory gauge invariant and supersymmetric. Solutions of the classical field equations are obtained, even if the scalar field potential has no critical points. Then a general analysis is made for the possible compactification of chiral N = 2D = 10 supergravity (which is the zero mass limit of the type IIB superstring theory) down to four dimensions. Finally the low-energy D = 4N = 1 supergravity that arises after compactification of the E sub 8 x E sub 8 superstring for an arbitrary number of generations is constructed. The couplings of all massless modes that carry low energy gauge quantum numbers are calculated by truncating the heavy Kaluza-Klein modes of the ten-dimensional effective field theory. The resulting action is compared to the most general effective action compatible with the symmetries of the underlying ten-dimensional field (and string) theories. Dissert. Abstr.

N87-16647 ESDU International Ltd., London (England).
HEAT CAPACITY AND ENTHALPY OF LIQUIDS: ALKENES AND ALKADIENES
Oct. 1986 31 p Supersedes ESDU-78015
(ESDU-86023; ISBN-0-85679-575-5; ISSN-0141-4062) Avail: ESDU

This Data Item ESDU 86023 is an addition to the Physical Data, Chemical Engineering Sub-series. Heat capacity and enthalpy data are given for 34 alkenes and 9 alkadienes at 10 K intervals between the normal melting point and 0.96 critical temperature along the saturation line. The data were obtained by fitting a polynomial equation to experimental data for heat capacity for each compound taken from a wide range of sources in literature; the constants of the equation were also faired with molecular structure for compounds that were members of the same chemical series. The enthalpy values were obtained by integrating the specific heat polynomial for each compound. The coefficients of the equations are tabulated together with values of critical temperature and normal melting point of each compound. An estimation of the accuracy of the predictions is included. ESDU

N87-16648# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OSCILLATORY BEHAVIOR OF FINITE DIFFERENCE METHODS FOR THE SOLUTION OF THE TWO DIMENSIONAL TRANSIENT HEAT (DIFFUSION) EQUATION M.S. Thesis
Joseph E. Cuthrell Mar. 1986 84 p
(AD-A172785; AFIT/GNE/ENP/86M-2) Avail: NTIS HC A05/MF A01 CSCL 20/13

The two dimensional transient heat (diffusion) equation with Dirichlet boundary conditions was solved using the Dufort-Frankel, Saul'ev, and Exponential (Power-law) finite difference schemes. All methods were investigated for oscillatory behavior and comparisons of accuracy made. To predict the time step at which oscillatory behavior would occur, the coefficient, matrix, and probabilistic methods of stability analysis were utilized. At time steps greater than the square of the mesh divided by the thermal diffusivity, oscillatory solutions were apparent in both the Dufort-Frankel and Saul'ev schems. The exponential method, as predicted, did not oscillate for any size time step. Although the exponential scheme was the most accurate at large time steps, the solution still contained enough error to be unusable in many engineering applications. At small time steps, all methods were more accurate than the fully implicit formulation. The exponential method was found to be the slowest computationally. The Saul'ev scheme proved to be the fastest while still achieving the required degree of accuracy. GRA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N87-16649# Rolls-Royce Ltd., Derby (England).
THE ROLE OF DESIGN IN THE MANAGEMENT OF TECHNOLOGY
J. F. Coplin 5 Aug. 1986 53 p
(PNR90329; ETN-87-98776) Avail: NTIS HC A04/MF A01

The process of design and the tools used to maximize the value of advanced technology are reviewed. ESA

N87-16650# Texas Univ., Austin. Graduate School of Business.
A STUDY OF ORGANIZATIONAL INFORMATION SEARCH, ACQUISITION, STORAGE AND RETRIEVAL Final Report, Nov. 1983 - May 1986
George P. Huber Aug. 1986 290 p
(Contracts MDA903-83-C-0440; DA Proj. 2Q1-61102-B-74-F)
(AD-A172063; ARI-RN-86-88) Avail: NTIS HC A13/MF A01 CSCL 05/1

The purpose of the study reported was to determine what is known and is not known about these organizational processes so that potential researchers and research resource providers might be wiser in their choice of research topics to study. Contents: Information Environments; How Organizations Learn: A Communication Framework; The Decision Making Paradigm of Organizational Design; Exploiting Information Technologies to Design More Effective Organizations; The Systems Paradigm in the Development of Organization Theory: Correcting the Record and Suggesting the Future; and Organizational Design: Proposed Theoretical and Empirical Research are presented. GRA

N87-16651# Science Applications, Inc., McLean, Va. Behavioral Sciences Research Center.
DEVELOPMENT OF A COMPUTER SIMULATION FOR ASSESSING DECISION-MAKING STYLE USING COGNITIVE COMPLEXITY THEORY Final Technical Report, Sep. 1979 - Mar. 1984
Robert W. Swezey, Siegfried Streufert, Eleanor L. Criswell, Kenneth W. Unger, and Paul VanRijn Sep. 1985 86 p
(Contracts MDA903-79-C-0699; DA Proj. 2Q2-63743-A-794)
(AD-A172064; SAI-84-04-178; ARI-TR-693) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report documents the design and development of a Managerial Assessment and Training Simulation System (MATSS). The MATSS is a computer-based simulation of a hypothetical military/political crisis in Yugoslavia in 1988. Participants act in the simulation to cope with the dilemma as the computer collects real-time data on their decision-making strategy. Measures of performance are based on interactive complexity theory, which is concerned with the structure rather than the content of decision making. Author (GRA)

N87-16652*# National Aeronautics and Space Administration, Washington, D.C.
HIGHLIGHTS OF CONTRACTOR INITIATIVES IN QUALITY ENHANCEMENT AND PRODUCTIVITY IMPROVEMENT
Jul. 1986 110 p
(NASA-TM-89266; NAS 1.15:89266; PB87-103750) Avail: NTIS HC A06/MF A01 CSCL 05A

The NASA/Contractor Team efforts are presented as part of NASA's continuing effort to facilitate the sharing of quality and

productivity improvement ideas among its contractors. This compilation is not meant to be a comprehensive review of contractor initiative nor does it necessarily express NASA's views. The submissions represent samples from a general survey, and were not edited by NASA. The efforts are examples of quality and productivity programs in private industry, and as such, highlight company efforts in individual areas. Topics range from modernization of equipment, hardware, and technology to management of human resources. Of particular interest are contractor initiatives which deal with measurement and evaluation data pertaining to quality and productivity performance. GRA

N87-16653*# National Aeronautics and Space Administration, Washington, D.C.
SUMMARY OF STRATEGIES FOR PLANNING PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT (PIQE)
Apr. 1986 40 p
(NASA-TM-89310; NAS 1.15:89310; PB87-103743) Avail: NTIS HC A03/MF A01 CSCL 05A

The Summary of NASA Strategies for Productivity Improvement and Quality Enhancement respond to NASA's eighth top goal: Establish NASA as a leader in the development and application of advanced technology and management practices which contribute to significant increases in both Agency and national productivity. The Strategies provide the framework for development of the agency-wide Productivity Improvement and Quality Enhancement (PIQE) Plans. GRA

N87-16749*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
OPERATIONS PLANNING AND ANALYSIS HANDBOOK FOR NASA/MSFC PHASE B DEVELOPMENT PROJECTS
Robert C. Batson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99) Avil: NTIS HC A99/MF E04 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N87-16654* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS (SUPPLEMENT 30)
Jan. 1987 50 p
(NASA-SP-7039(30)-Sect-1; NAS 1.21:7039(30)-Sect-1) Avail: NTIS HC A03 CSCL 05B

Abstracts are provided for 105 patents and patent applications entered into the NASA scientific and technical information system during the period July 1986 through December 1986. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application. Author

N87-16655*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY, 1985
15 Dec. 1986 35 p
(NASA-CR-180100; JPL-BIBL-39-27; NAS 1.26:180100) Avail: NTIS HC A03/MF A01 CSCL 05B

This bibliography describes and indexes by primary author the externally distributed technical reporting, released during calender year 1985, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Three classes of publications are included: JPL publications in which the information is complete for a specific accomplisment; Articles from the quarterly Telecommunications and Data Acquisition (TDA) Progress Report; and article published in the open literature. Author

N87-16656*# Houston Univ., Tex. Dept. of Computer Science.
DATABASE INTERFACES ON NASA'S HETEROGENEOUS DISTRIBUTED DATABASE SYSTEM Semiannual Report, 11 Feb. 1987
Shou-Hsuan Stephen Huang 1987 35 p
(Grant NAG5-739)
(NASA-CR-180120; NAS 1.26:180120) Avail: NTIS HC A03/MF A01 CSCL 05B

The purpose of Distributed Access View Integrated Database (DAVID) interface module (Module 9: Resident Primitive Processing Package) is to provide data transfer between local DAVID systems and resident Data Base Management Systems (DBMSs). The result of current research is summarized. A detailed description of the interface module is provided. Several Pascal templates were constructed. The Resident Processor program was also developed. Even though it is designed for the Pascal templates, it can be modified for templates in other languages, such as C, without much difficulty. The Resident Processor itself can be written in any programming language. Since Module 5 routines are not ready yet, there is no way to test the interface module. However, simulation shows that the data base access programs produced by the Resident Processor do work according to the specifications. B.G.

N87-16657# Defense Technical Information Center, Alexandria, Va. Office of Information Systems and Technology.
PROCEEDINGS OF THE 2ND CONFERENCE ON COMPUTER INTERFACES AND INTERMEDIARIES FOR INFORMATION RETRIEVAL Summary Report
Carol E. Jacobson and Shirley A. Witges May 1986 379 p
Proceedings held in Boston, Mass., 28-31 May 1986; sponsored in part by MIT
(AD-A174000; DTIC/TR-86/5) Avail: NTIS HC A17/MF A01 CSCL 05/2

These proceedings consist of papers and product descriptions presented at the conference which was jointly sponsored by the Defense Technical Information Center and the Massachusetts Institute of Technology. The purpose of this conference was to bring together experts in the field of user interfaces and gateways for information retrieval systems. Twenty eight speakers presented papers in the following areas of interest: artificial intelligence in retrieval, gateways, interfaces, common command language, and natural language. GRA

N87-16658# Defense Technical Information Center, Alexandria, Va. Office of Information Systems and Technology.
THE DOD GATEWAY INFORMATION SYSTEM DIRECTORY OF RESOURCES Final Report
Carol E. Jacobson and Gladys A. Cotter Aug. 1986 15 p
(AD-A174154; DTIC/TR-86/8) Avail: NTIS HC A02/MF A01 CSCL 05/2

The Defense Technical Information Center (DTIC) is sponsoring development of a DoD Gateway Information System (DGIS) to provide online, streamlined methods for identifying, accessing, searching and analyzing data from heterogeneous databases of interest to the DOD community. At the core of the gateway system is a Directory of Resources which contains information on the content, scope and availability of selected databases. Presently, the Directory references over 430 DOD-sponsored R&D databases, but this figure is expected to grow to over 3,000 when coverage is expanded to include additional DOD, other federal, and commercial databases. The prototype Directory runs on a VAX 11/780 minicomputer using the INGRES database management system and is available to a select community of users for test and evaluation. A critical feature is the menu-driven interface designed to assist end-users. This paper describes data collection, database design, implementation of the Directory and menu-driven interface, and future directions. GRA

N87-16659# Naval Postgraduate School, Monterey, Calif.
SOFTWARE PORTABILITY: A CASE STUDY OF THE MULTI-BACKENDED DATABASE SYSTEM M.S. Thesis
Bruce D. Silberman Jun. 1986 104 p
(AD-A174179) Avail: NTIS HC A06/MF A01 CSCL 09/2

The multi-backend database system (MBDS) is a database system designed for very large database. MBDS is intended to provide consistent performance with increased capacity (or improved performance at a sustained capacity) by distributing the work of the system among several micro-computers connected to a common communication network. One of the issues central to the MBDS design is the potability of the system's software. This thesis provides a general discussion of the issues involved in software portability, and then presents a case study of the MBDS software system. Author (GRA)

N87-16660# Sandia National Labs., Albuquerque, N. Mex.
DATA ENGINEERING
J. R. Yoder 1986 7 p Presented at the Fall Digital Equipment Computer Users Society Symposium, San Francisco, Calif., 6 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-015206; SAND-86-1850C; CONF-8610128-2) Avail: NTIS HC A02/MF A01

Data Engineering can be defined as the application of computing, science, mathematics, communications, and other engineering disciplines to the transformation of data into information. A Data Engineer is a member of a group devoted to data engineering or is one who is trained in or follows as a profession the practice of data engineering. This paper describes the application of data engineering to the development and operation of a large VAXcluster based product validation data system. The system has many sources spread over the country, hundreds of users, and several important constraints. Data engineering is required to assure continuity of data acquisition, transmission, storage, retrieval, and analysis. A large volume of data must be reduced and analyzed with user friendly, interactive tools that provide broad capabilities in signal processing, statistics, and graphics. The use of artificial intelligence (expert systems and pattern recognition) will be a significant aid to improving system utility. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N87-16661# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
AN EXAMINATION OF BRAZIL AND THE US AS POTENTIAL PARTNERS IN A JOINT SUPERSONIC MILITARY FIGHTER AIRCRAFT CODEVELOPMENT AND PRODUCTION PROGRAM M.S. Thesis
Rockford J. Reiners Sep. 1986 179 p
(AD-A174118; AFIT/GLM/LSM/86S-64) Avail: NTIS HC A09/MF A01 CSCL 05/4

This thesis examines whether Brazil and the U.S. could be suitable partners in a joint supersonic military fighter aircraft program. The primary research method was a literature review accompanied by correspondence with the national aircraft corporation of Brazil, Embraer. The research was divided into seven areas for study: aircraft design factors, aircraft production factors, aircraft operation requirements, business concerns, current activities, possible future actions and Brazilian-U.S. relations. In addition, three approaches for a Brazilian supersonic fighter development were investigated: licensing, joint venture and internal development. The results of this research indicate that Brazil and the U.S. could be suitable partners for a joint supersonic fighter development program if the technology transfer and third country export requirements can be worked out to the satisfaction of both countries. Currently Brazil has approval rights for all exports of Brazilian goods containing U.S. technology. Author (GRA)

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N87-16662# Executive Office of the President, Washington, D.C.
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT: 1985 ACTIVITIES
1986 132 p
Avail: NTIS HC A07/MF A01

The achievements of aeronautics and space programs in the United States for 1985 are summarized in the areas of communications; Earth atmosphere, environment, and resources; space science; space transportation; commercial use of space; space tracking and data systems; space station; and aeronautics and space research and technology. The achievements of each of the following organizations are described: National Aeronautics and Space Administration, Department of Defense, Department of Commerce, Department of Energy, Department of the Interior, Department of Agriculture, Federal Communications Commission, Department of Transportation, Environmental Protection Agency, National Science Foundation, Smithsonian Institution, Department of State, Arms Control and Disarmament Agency, and United States Information Agency. Appendices provide historical information on launches, satellites, manned and unmanned spacecraft, and federal budgets for aeronautical and astronautical activities. J.P.B.

N87-16663*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF THE 1986 FREE-PISTON STIRLING ACTIVITIES AT NASA LEWIS RESEARCH CENTER
Donald L. Alger Oct. 1986 17 p Presented at the 24th Automotive Technology Development Contractors Coordination Meeting, Dearborn, Mich., 27-30 Oct. 1986; sponsored by DOE
(NASA-TM-88895; E-3312; NAS 1.15:88895) Avail: NTIS HC A02/MF A01 CSCL 13F

An overview of the NASA Lewis Research Center's free-piston Stirling engine research is presented, including efforts to improve and advance its design for use in specific space power applications. These efforts are a part of the SP-100 program being conducted to support the Department of Defense (DOD), Department of Energy (DOE) and NASA. Such efforts include: (1) the testing and improvement of 25 kWe Stirling Space Power Demonstrator Engine (SPDE); (2) the preliminary design of 25 kWe single-cylinder Experimental stirling Space Engine (ESSE); and, (3) a study to determine the feasibility of scaling a single-cylinder free-piston Stirling engine/linear alternator to 150 kWe. Other NASA Lewis free-piston Stirling engine activities will be described, directed toward the advancement of general free-piston Stirling engine technology and its application in specific terrestrial applications. One such effort, supported by DOE/Oak Ridge National Laboratory

(DRNL), is the development of a free-piston Stirling engine which produces hydraulic power. Finally, a terrestrial solar application involving a conceptual design of a 25 kWe Solar Advanced Stirling Conversion System (ASCS) capable of delivering power to an electric utility grid will be discussed. The latter work is supported by DOE/Sandia National Laboratory (SNLA). Author

N87-16664*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF WATER ON HYDROGEN PERMEABILITY Final Report
David Hulligan and William A. Tomazic Jan. 1987 25 p
(Contract DE-AI01-85CE-50112)
(NASA-TM-88898; E-3321; DOE/NASA-50112-68; NAS 1.15:88898) Avail: NTIS HC A02/MF A01 CSCL 07D

Doping of hydrogen with CO and CO2 was developed to reduce hydrogen permeation in Stirling engines by forming a low permeability oxide coating on the inner surface of the heater head tubes. Although doping worked well, under certain circumstances the protective oxide could be chemically reduced by the hydrogen in the engine. Some oxygen is required in the hydrogen to prevent reduction. Eventually, all the oxygen in the hydrogen gas - whatever its source - shows up as water. This is the result of hydrogen reducing the CO, CO2, or the protective inner surface oxides. This water can condense in the engine system under the right conditions. If the concentration of water vapor is reduced to a low enough level, the hydrogen can chemically reduce the oxide coating, resulting in an increase in permeability. This work was done to define the minimum water content required to avoid this reduction in the oxide coating. The results of this testing show that a minimum of approximately 750 ppm water is required to prevent an increase in permeability of CG-27, a high temperature metal alloy selected for Stirling engine heater tubes. Author

N87-16665# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUTURE AND DEVELOPMENT (SELECTED ARTICLES)
Xuming Lu, Juezhou Huang, Yingbai Liu, and Yicheng Wang 27 Aug. 1986 40 p Transl. into ENGLISH from Wei Lai Yu Fazhan (China), v. 6, no. 3, 1985 p 1-13
(AD-A171888; FTD-ID(RS)T-0130-86) Avail: NTIS HC A03/MF A01 CSCL 05/1

This translation of a Chinese journal concerns the future and development of scientific technology. Some article titles are: The Strategy of Development of High Technology in China; The Leaping Mode and the Strategy of Technology Development; The Multi-Level Strategy of Technology Development; Several Problems Which Require Appropriate Disposal During Carrying Out the Strategy of Multi-Level Technology Development; and Science Prediction is the Basis for Making the Strategy of Technology Development. GRA

N87-16666# Office of Naval Research, London (England).
EUROPEAN SCIENCE NOTES, VOLUME 40, NUMBER 10 Monthly Report
C. J. Fox Oct. 1986 73 p
(AD-A172469; ESN-40-10) Avail: NTIS HC A04/MF A01 CSCL 05/2

European Science Notes is a monthly publication with brief articles on recent developments in European scientific research. Partial contents of this issue: Educational Psychology in Spain; Report on the Life Sciences Conference--From Enzymology to Cellular Bilogy; Early Steps toward an Optical computer; jSymposium on Finite Element Methods and Flow Problems; 18th International Liege Colloquium on Models and Modeling; Conference on Integrated Optics; Theoretical Work on Laser-Induced Scattering, Atomic Physics, and Wiggler Design at Innsbruck. GRA

N87-16667# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A METHODOLOGY FOR ASSESSING TECHNOLOGY TRADE-OFFS OF SPACE-BASED RADAR CONCEPTS M.S. Thesis
John E. Puffenbarger Dec. 1985 161 p
(AD-A172529; AFIT/GSO/ENS/85D-13) Avail: NTIS HC A08/MF A01 CSCL 17/9

A methodology is developed to aid a decision maker in assessing the technology trade-offs for space system concepts. A review of systems engineering and the tools of operations research shows that the analytic hierarchy process provides a suitable basis for this methodology. The possible concept options that fall under the overall space-based radar concept are representative of the multiple trade-offs inherent in planning for future space systems. Many of the technology issues appropriate to space-based radar concepts are presented to establish a foundation for the methodology. The proposed methodology exposes the three phases of the analytic hierarchy process and how they interact to provide an overall priority for a selected number of concept options. Particular emphasis is placed on the division of the decision process according to a decision hierarchy and a support hierarchy. A key feature of such an approach is its compatibility with the format and terminology of the Military Space Systems Technology Plan developed by the Air Force Space Technology Center. GRA

N87-16668# La Jolla Inst., Calif.
IDENTIFICATION OF NEW POTENTIAL SCIENTIFIC AND TECHNOLOGY AREAS FOR DOD APPLICATION. SUMMARY OF ACTIVITIES Final Technical Report, 1 Apr. 1985 - 31 Jul. 1986
P. Hammerling 31 Jul. 1986 317 p
(Contracts MDA903-85-C-0187; ARPA Order 3710)
(AD-A173000; LJI-LJ-86-403) Avail: NTIS HC A14/MF A01 CSCL 05/1

The purpose of the La Jolla Institute's (LJI) technology innovation search program for DARPA is to identify, for consideration of support at universities, research areas either outside of current DARPA programs which could provide the basis for new programs or those, which though they fall within existing programs, offer a significant new approach or idea clearly affecting the program's goals. This search process has been mainly, though not uniquely, confined to universities and makes use of LJI's staff and network of Associates to write reports, convene workshops, etc. to bring both new and overlooked areas to DARPA's attention. In this document are summarized some of this years's program activities. Complete copies of the longer reports are reproduced in the Appendix. Contents: Report on the Polymer Flow Workshop, Preliminary Report on the Use of Anti-Matter; Comments on the Strategic Computing Program at IPTO; Meeting on Low-Dimensional, Quantum-Well Structures; DoD Applications of Electromagnetic Launch (EML) Technologies; Strategic Computing Applications Program; Four Papers on Robotics; Strategy for Complex Organization Modeling, Planning and Experiment (SCOMPLEX) are presented. GRA

N87-16669# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
AN EXPLORATORY STUDY OF DOMESTIC TECHNOLOGY TRANSFER CONCEPTS, FEDERAL INFRASTRUCTURE AND PROCESS MODELS M.S. Thesis
Paul A. Dawson Sep. 1986 110 p
(AD-A174541; AFIT/GLM/LSM/86S-14) Avail: NTIS HC A06/MF A01 CSCL 05/1

A narrative review of concepts and issues related to domestic technology transfer is given. Six investigative questions are posed which form a framework for analysis. First, what definitions of technology, innovation, and technology transfer have been advanced, and what other concepts are relevant. Second, what factors have been identified as promoting or impeding technology transfer? Third, what important roles do individuals fulfill in technology transfer? Fourth, what is the Federal infrastructure for promoting technology transfer? Fifth, what is DOD's role in promoting domestic technology transfer? Sixth, what models have been advanced to portray the technology transfer process? The literature review indicates that innovation research provides a large body of knowledge related to factors influencing technology transfer, and factors can be grouped as pertaining to management involvement or the source - user relationship. In the Federal

infrastructure for technology transfer, there are notable active systems, but funding appears to be a continuing problem. Although technology transfer from DOD to other sectors is predominantly passive, a trend toward active programs is observed. GRA

88 SPACE SCIENCES (GENERAL)

N87-16670 Centre National d'Etudes Spatiales, Toulouse (France).
PROCEEDINGS OF A CONFERENCE ON THE COMPARATIVE STUDY OF MAGNETOSPHERIC SYSTEMS
1986 639 p Partly in FRENCH; ENGLISH summary Conference held in La Londe les Maures, France, 1986
(ISBN-2-85428-153-5; ETN-86-98413) Copyright. Avail: CEPADUES-Editions, Toulouse, France

Large scale magnetospheric processes (interaction between two plasmas, large scale circulation, instabilities of plasma reservoirs); and microscopic processes (particle energization and the role of low frequency turbulence, high frequency plasma waves and electromagnetic radiation) were discussed. For individual titles, see N87-16671 through N87-16717.

N87-16671 Leeds Univ. (England). Dept. of Applied Mathematics.
PLASMA JETS FROM ACTIVE GALACTIC NUCLEI **c75**
S. A. E. G. Falle *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 16-24 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Observations of extragalactic radio sources are reviewed and interpreted as being due to supersonic plasma jets generated in the nuclei of active galaxies. The jets are not relativistic and are confined by an external medium rather than by magnetic effects. This means that simple gas-dynamic models should apply, and where such models can be tested against observations, they seem to agree quite well. However, if the magnetic field is frozen into the fluid, then there must be regions where the magnetic field dominates the dynamics. Also, since the radio emission is produced by the synchrotron process, knowledge of the magnetic field is essential for a proper interpretation of the radio emission. The galactic object SS433 can provide useful clues as to the nature of the extragalactic jets. The source appears to be an accretion disk around a dense object which could be a neutron star or a black hole. Since SS433 is simply a scaled down version of the extragalactic objects, it seems likely that the extragalactic jets are produced by a similar mechanism. ESA

N87-16672 Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
MAGNETOSPHERES OF ACCRETING COMPACT OBJECTS IN BINARY SYSTEMS **c90**
J. J. Aly *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p25-36 In FRENCH; ENGLISH summary (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Bright pulsating X-ray sources identified as strongly magnetized compact objects accreting matter from a binary companion are discussed. The interaction between the magnetic field of the compact object and its surroundings is examined. Models describing the interaction of the field with a spherically symmetric accretion flow; a thin keplerian accretion disk; and the companion itself are reviewed. How the external plasma interacting with the magnetosphere can get mixed with the field; and the mechanism by which the magnetic field controls the mass-momentum-energy exchanges between the two stars are discussed. The magnetosphere of an accreting compact object is compared with that of a planet. ESA

N87-16673 Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
MAGNETOSPHERES OF PULSARS **c90**
Michel F. Curtis *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 37-44 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Theoretical understanding of how nonneutral plasmas influence the particle and field distribution about rotating magnetized neutron stars is reviewed. For perfectly aligned dipole models, total particle trapping is found. This trapping seems to persist even to large angles of obliquity between the rotation and dipole axes. Observation suggests, however, that active pulsars are observed with nearly aligned axes. Possible role of a kepler disk in the pulsar system is explored to resolve this problem. Aspects of this system may be found in the case of Saturn. ESA

N87-16674 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC CONFIGURATIONS OF PLANETARY OBSTACLES **c92**
R. P. Lepping *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 45-75 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The interaction between planetary magnetospheres and solar wind flow is discussed. A proper planetary magnetosphere results from the interaction of a flowing plasma with a planet having an intrinsic, global, magnetic field of sufficient strength to stand off the impinging plasma. Upstream of such an obstacle a bow shock usually exists. The known magnetospheres have severely asymmetric shapes, being elongated approximately along the solar wind flow direction. Conditions which fundamentally determine the structure of a proper planetary magnetosphere are the state of the externally flowing plasma, the planet's magnetic moment, its vector spin, and the presence and nature of internal plasma sources and any plasma sinks. Planets known to have proper magnetospheres are Earth, Mercury, Jupiter, and Saturn. Uranus and Neptune may also have magnetospheres, with that of Uranus promising to have an exotic field configuration, because the planet's magnetic moment is expected to be nearly aligned with the solar wind flow direction. Venus and Mars are also discussed. Magnetopause surface waves are mentioned. ESA

N87-16675 Oesterreichische Akademie der Wissenschaften, Vienna. Space Research Inst.
ANALYTICAL MODELS OF PLANETARY MAGNETOSPHERES **c90**
H. K. Biernat, N. I. Koemle, H. I. M. Lichtenegger, and H. O. Rucker *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 77-80 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The origin and structure of planetary magnetospheres are analyzed. Structure is essentially determined by the magnetic source and its orientation with respect to solar wind flow. Earth-like magnetospheres have a dipolar magnetic source and the solar wind flow direction is approximately perpendicular to the dipole axis. A second type of magnetosphere arises if the dipole is oriented parallel to the solar wind flow, which most probably occurs at Uranus near the solstitial points of its orbit. A further configuration might occur at the Earth and at other planets when the magnetic dipole reverses its orientation. In the case of a vanishing dipole moment, the remaining quadrupole moment of the transitional field becomes dominant, which leads to a completely different magnetospheric structure. These magnetospheric configurations are modelled within two dimensions with a conformal mapping method, leading to analytical and self-consistent results. ESA

N87-16676 Centre National d'Etudes Spatiales, Toulouse (France).
A MAGNETIC FIELD MODEL OF THE EARTH'S MAGNETOSPHERE **c46**
J. Cl. Kosik *In its* Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 81-88 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Combinations of toroidal and poloidal vector fields are used

to obtain a simple model of the Earth's magnetospheric magnetic field. The model is tilt-dependent and can be adjusted to the geomagnetic conditions. The 0-tilt model is described with 3 functions and 6 coefficients and the Mead model is a particular case. The tilt model is described by adding two functions and four coefficients. The tilt model presents two anomalies: escape of the field lines in the noon meridian for high tilt angles (also observed in the models of Olson-Pfitzer and Tsyganenko); and poor modeling of high latitude field lines in the midnight meridian, due to the lack of a tail field. ESA

N87-16677 Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
ACCELERATION OF PARTICLES BY SHOCKS IN HIGH BETA PLASMAS **c75**
L. OC. Drury *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 93-98 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The plasma shock drift process is discussed; it is shown that for hyperkinetic particles this effect is already included in diffusive shock acceleration. Reaction effects are mentioned. Particles experience small energy changes on interaction with shock fronts, the exception being at quasiperpendicular shocks where slow energetic particles can be reflected with large energy gains. However if particles can interact many times through diffusive scattering the final effect is large and leads to powerlaw tails in the distribution function and ultimately to major dynamical effects on the shock structure. ESA

N87-16678* Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.
ENERGETIC IONS UPSTREAM OF PLANETARY BOW SHOCKS: FERMI ACCELERATION OR LEAKAGE **c90**
S. M. Krimigis *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 99-124 Sponsored in part by NASA (For primary document see N87-16670 08-88)
(Contract N000-24-85-C-5301)
Avail: CEPADUES-Editions, Toulouse, France CSCL 03B

Spacecraft observations of Jupiter, Saturn, and Earth planetary bow shocks are assessed. For Jupiter, the unique composition of magnetospheric plasma, where oxygen and sulfur ions are major components, and the simultaneous presence of MeV electrons enable identification of the upstream particles as originating from within the magnetosphere. The observations at Saturn are phenomonologically similar, but no unique tracer element exists which can identify the origin. Earth observations show that substantial energetic particle activity occurs within the Earth's plasma sheet when upstream ions and electrons are observed in the interplanetary medium. Observations of the three planets are discussed to compare in-situ acceleration in the foreshock region vs. leakage of already accelerated ions from the parent magnetosphere. It is concluded that the evidence favors magnetospheric leakage. ESA

N87-16679 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
TRANSFER THROUGH MAGNETOPAUSES **c90**
Goetz Paschmann *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 125-129 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Reconnection, diffusion, K-H instability, impulsive penetration, and magnetic drift processes which transfer mass, momentum, and energy across planetary magnetopauses are reviewed. Observations which pertain to the occurrence and relative efficiency of these processes are discussed. Observations at Earth suggest that magnetic reconnection is the most powerful transfer process. ESA

N87-16680* Imperial Coll. of Science and Technology, London (England). Blackett Lab.
INTERACTIONS WITH PLANETARY IONOSPHERES AND ATMOSPHERES: A REVIEW
Mark A. Saunders (Imperial Coll. of Science and Technology, London (England).), Christopher T. Russell (California Univ., Los Angeles.), and Janet G. Luhmann *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 131-147 Sponsored in part by UK SERC (For primary document see N87-16670 08-88)
(Contracts NAS2-9491; NASw-717)
Avail: CEPADUES-Editions, Toulouse, France CSCL 03B

The interaction of the solar wind with unmagnetized objects possessing an ionosphere is reviewed. Venus, Mars, Titan, comets (including the artificial comet created by AMPTE) and the unusual interplanetary events interpreted as cometesimals are considered. The role of the interplanetary magnetic field and of mass loading in producing the observed interactions is highlighted. Interpretation to date is based largely on an MHD (fluid) treatment, but results from the first AMPTE barium release and from recordings made at Venus suggest that finite Larmor radius effects introduce asymmetries in the solar wind interaction. ESA

N87-16681 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
POLAR WIND AND PLANETARY ORIGIN ION ESCAPES AT HIGH LATITUDES **c46**
H. Reme *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 149-183 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Satellite and ground measurements in the polar regions showing a depletion of light ionosphere ions (H+ and He+) and electrons are discussed. The cause of this depletion is a continual escape of ionospheric light ions and electrons along open magnetic field lines. This plasma is too energetic to be gravitationally bound and with the condition of zero pressure at infinity there is an outward flow of plasma termed the polar wind, in analogy with the flow of solar plasma away from the Sun. In addition to this classical polar wind, ions with energies from a few eV to a few hundred eV are regularly observed flowing upward out of the polar cap ionosphere with O(+) usually as the dominant species. Time dependent theoretical hydrodynamical models of the polar wind suggest that temporary supersonic outflows of O(+) and H(+) could develop as transients. ESA

N87-16682 Bulgarian Academy of Science, Sofia. Central Lab. for Space Research.
PLASMA DYNAMICS AND FIELD-ALIGNED CURRENT REVERSALS IN THE DAYSIDE OVAL **c75**
A. Z. Bochev, I. S. Arshinkov, and P. I. Nenovsky *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 185-188 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Reversals of the field-aligned currents (FAC) in the cusp sector (10 to 14 MLT) are examined: cusp current absence at clearly distinguished regions 1 and 2 at the equatorial boundary of the dayside oval; and cusp current and region 1 FAC penetration into the cusp as apart from the magnetopause. Cusp plasma dynamics as deduced from electric field, particle flux, simultaneously with magnetometer data from the Intercosmos Bulgaria-1300 satellite are discussed. ESA

N87-16683* Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
SOLAR WIND-PLASMA INTERACTION: THE AMPTE SOLAR WIND PLASMA RELEASES
In CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 189-195 Sponsored in part by UK Science and Engineering Research Council, and Bundesministerium fuer Forschung und technologie (For primary document see N87-16670 08-88)
(Grants NGL-16-001-002; NGL-16-001-043; Contracts N00014-82-K-0183; N00014-76-C-016; F04701-84-C0085;

N00014-84-K-0160)
Avail: CEPADUES-Editions, Toulouse, France

In situ measurements during AMPTE solar wind ion releases are described. The creation of a diamagnetic cavity, compression and draping of magnetic field lines, recoil of the entire artificial comet, and ion beam and tail formation are discussed. The wave measurements were used to determine the time variation of the plasma density from the measurement of the electron plasma frequency and to determine the state of cloud expansion and cavity formation. Features found include absence of strong turbulence and anomalous diffusion in the cavity boundary, and the appearance of very intense shock-like emission in front of the plasma clouds. The first effect suggests partially unknown processes leading to magnetic field penetration into the region of the clouds. The direct observation of the interaction processes between the fast streaming solar wind plasma and the expanding cloud plasma of the Li and artificial comet releases may have relevance to astrophysical situations as, for instance, encountered in solar flares, interstellar clouds, or during accretion of matter onto compact objects. ESA

N87-16684 Rice Univ., Houston, Tex. Center for Space Physics.
CONVECTION IN PLANETARY MAGNETOSPHERES c90
T. W. Hill *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 201-215 (For primary document see N87-16670 08-88)
(Grants NSF ATM-83-06772; NSF ATM-83-11146)
Avail: CEPADUES-Editions, Toulouse, France

Bulk motion of magnetospheric flux tubes, powered either internally by an unstable distribution of plasma produced therein, or externally by coupling to the motion of an adjacent medium is described. Internally powered convection results from one of three types of magnetospheric interchange instability: flute instability associated with a plasma pressure distribution containing excess internal energy of compression; Rayleigh-Taylor instability deriving from a plasma mass distribution containing excess gravitational potential energy; and centrifugal instability, the inverse of Rayleigh-Taylor instability, occurring outside the synchronous orbit radius. Centrifugal instability is primarily responsible for convection in the magnetosphere of Jupiter, and probably also that of Saturn. Externally powered convection may be driven either by atmospheric winds, coupled to the magnetosphere by ionospheric Pedersen currents, or by the solar wind, coupled to the magnetosphere by one or more collisionless momentum transfer processes. The solar wind is the primary driver of convection in Earth's magnetosphere, and the primary coupling mechanism is interconnection between the geomagnetic and interplanetary magnetic fields. ESA

N87-16685 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
EQUILIBRIA OF PLASMA RESERVOIRS IN PLANETARY MAGNETOSPHERES c90
G. Caudal and M. Blanc *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 217-244 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The plasma content and distribution of high-beta reservoirs in planetary magnetospheres are discussed. A mechanical equilibrium has to be maintained, in which the forces exerted on the plasma by gravity, inertial effects (including the centrifugal force and flow acceleration) and pressure gradients are balanced by the Lorentz force due to the currents generated by these forces. The magnetic effect of these currents in turn distorts the initial planetary magnetic field, leading to various stretched field line configurations. In the simplest situations a stationary equilibrium can be calculated, given a distribution of plasma content and pressure per flux tube, by solving a nonlinear partial differential equation with appropriate boundary conditions. But the amount of plasma confined in the reservoir also depends on the balance of plasma exchange between the reservoir and the surrounding regions. The quantitative description of this plasma exchange usually involves large-scale flow into and out of the reservoir, plasma diffusion across its boundaries, and even magnetic reconnection. ESA

N87-16686* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATURN: A UNIQUE MAGNETOSPHERE/IONOSPHERE/RING INTERACTION c91
J. E. P. Connerney *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 245-251 Sponsored by NASA (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France CSCL 03B

Latitudinal variations in images of Saturn's disk, upper atmospheric temperatures, and ionospheric electron density anomalies found in magnetic conjugacy with features in Saturn's ring plane are discussed. It is suggested that latitudinal variations are the result of a variable influx of water, transported along magnetic field lines from sources in Saturn's ring plane. Two such sources with optical counterparts in the inner B ring can be readily attributed to an electromagnetic erosion process that transports water in the form of high charge to mass ratio particles (ions or submicron grains with 1 electron charge) along magnetic field lines from the ring plane to Saturn's atmosphere. Another is attributed to erosion of the icy satellite Enceladus and the associated E ring. ESA

N87-16687 California Univ., Los Angeles.
PLASMA COROTATION IN THE JOVIAN AND KRONIAN MAGNETOSPHERES c91
A. Eviatar, J. D. Richardson (Massachusetts Inst. of Tech., Cambridge.), and R. L. McNutt, Jr. *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 253-258 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Plasma velocities in Jupiter's and Saturn's magnetospheres were derived from the Voyager plasma experiment. Results show that Jupiter and Saturn differ greatly in their imposition of corotation on their magnetospheres. Jupiter's relatively large ionospheric conductance allows it to maintain near-corotation throughout its inner magnetosphere despite the large mass-loading rate in the Io torus. Flow deviates significantly from corotation only outside L = 20 due to the outflow of Io torus plasma. Saturn's very small ionospheric conductance enables even weak plasma sources such as Dione and Rhea to reduce azimuthal velocities to a fraction of corotation. In the outer magnetosphere velocities recover to within 80% of corotation. ESA

N87-16688 Nagoya Univ. (Japan).
INTERPLANETARY MAGNETIC FIELD (IMF) CONTROL AND CONVECTION IN THE JOVIAN MAGNETOSPHERE c91
A. Nishida and K. Maezawa *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 259-262 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The reconnection mechanism thought to operate in the Earth's magnetosphere is considered as a means for the energy transfer from the solar wind to the Jovian magnetosphere. Variations in interplanetary magnetic field (IMF) polarity during the estimated connection time of weeks would result in a complex configuration of open field lines as orientations of their constituents differ widely, reflecting the history of the IMF polarity during the interval of weeks. The reconnection can still be expected to proceed smoothly as long as the reconnected field lines are transported antisunward one after another, without acting as an obstacle to the convection of field lines that follow. If the reconnection proceeds sporadically in time and/or locally in space in a limited part of the magnetopause, the reconnected flux tubes would be isolated and look like flux transfer events. The dynamics of such isolated flux tubes would be controlled even more tightly by the bulk flow of the solar wind as compared to when most of the IMF field lines are reconnected, because unreconnected field lines which constitute the majority would collaborate to carry the reconnected field lines with them. ESA

N87-16689 Tokyo Univ. (Japan). Geophysics Research Lab.
INSTABILITIES AT PLASMA INTERFACES c75
Akira Miura *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 265-275 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Linear and nonlinear characteristics of instabilities at plasma interfaces, Kelvin-Helmholtz and Rayleigh-Taylor instabilities, are reviewed in the framework of hydrodynamic and magnetohydrodynamic approximations, emphasizing basic physical processes of these instabilities occuring in the neighborhood of the magnetospheric boundary of space and astrophysical objects. In the linear regime, effects of the magnetic field, compressibility, and finite thickness of the plasma interface on these instabilities are important and their effects on instabilities at plasma interfaces are discussed by an intuitive argument. Nonlinear evolutions of these instabilities are crucial in understanding transport of mass, momentum, and energy into the magnetosphere of space and astrophysical objects. ESA

N87-16690 Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
CONVERSION OF MAGNETIC ENERGY VIA COLLISIONLESS TEARING MODES: APPLICABILITY OF EXISTING THEORIES TO OBSERVATIONS IN THE EARTH'S MAGNETOTAIL c46
A. Nishida, T. Terasawa, and M. Hoshino *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 277-295 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Magnetohydrodynamic reconnection theories and kinetic theories of the collisionless tearing mode instability are surveyed. Any collisional reconnection model requires existence of an anomalous resistivity. However, this requirement seems difficult to obtain in the real magnetotail. For the concept of ion tearing instability to be valid, the contribution of magnetized electrons should be supressed by a physical mechanism, such as a pitch angle scattering of electrons. If such a mechanism is absent, the magnetized electron would totally control the reconnection process. Examples are the electrostatic stabilization of the tearing mode in the two-dimensional plasma sheet and the Hall current effect. As well as collecting further information on the nature and role of respective reconnection processes in the magnetospheric dynamics, observations in the magnetotail have to address plasma isotropy and the response of the plasma sheet to the enhanced dayside reconnection rate. ESA

N87-16691 California Univ., Los Angeles. Dept. of Physics.
LABORATORY EXPERIMENT ON MAGNETIC RECONNECTION AND CURRENT DISRUPTIONS c75
R. L. Stenzel, W. Gekelman, and J. M. Urrutia *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 297-306 (For primary document see N87-16670 08-88)
(Contract AFOSR-F19628-85-K-0003; Grants NSF ATM-84-01322; NSF PHY-84-10495)
Avail: CEPADUES-Editions, Toulouse, France

A neutral sheet was formed by applying time varying opposing magnetic fields to a highly conducting plasma. Complete diagnostics for the three-dimensional magnetic field topology, particle distribution, fluid properties, and waves were developed. Quasi-stationary reconnection is observed and understood, to first order, by fluid models, but is modified by kinetic effects (anisotropies, microinstabilities, space charge fields). Spontaneous disruptive instabilities of a current sheet are observed when one approaches other. Inductive voltages form double layers where energetic particles are formed. The conversion of stored magnetic energy into particle kinetic energy is studied by a controlled interruption of the plasma current. The disrupted current sheet self-consistently cascades into small scale current structures (loops, filaments) which evolve into spatial turbulence. The magnetic field energy is dissipated anomalously fast while the plasma is energized and waves are generated. ESA

N87-16692 Finnish Meteorological Inst., Helsinki. Dept. of Geophysics.
IONOSPHERIC SIGNATURES OF LARGE-SCALE INSTABILITIES IN THE MAGNETOTAIL c46
Risto J. Pellinen *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 307-314 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Auroral arc brightening in the midnight sector of the auroral oval is considered as a signature of instability onset. Investigation of optical and other ionospheric data reveals that the arc brightening propagates at high speed away from the midnight meridian towards east and west. The brightening is followed by the formation of an auroral bulge that expands towards east and west with an order of magnitude lower speed. In the arc brightening the amount of precipitating particles increases, not the energy, while in the auroral bulge there is considerable energization. The two-mode propagation in the magnetospheric scale is explained. Arc brightening is associated with the formation of a near-earth neutral line in the magnetotail. If a plasmoid east-west dimension is 20 RE, a full-size plasmoid forms in 2 min, in agreement with other observations. The growth of the auroral bulge agrees with the estimated local ExB speeds in the instability region. ESA

N87-16693* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEUTRAL SHEET CROSSINGS BY ISEE-3 IN THE DISTANT MAGNETOTAIL
W. J. Heikkila (Danish Space Research Inst., Lyngby.), J. A. Slavin, E. J. Smith, D. N. Baker (Los Alamos National Lab., N. Mex.), and R. D. Zwickl *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 315-322 Sponsored by NASA, and DOE (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Magnetic field data from ISEE-3 in the distant magnetotail at crossings of the field reversal (or neutral sheet) region were analyzed to determine the instantaneous direction of the normal component Bz at the crossing. A crossing identified as being almost always tailward of the steady-state X-line was selected. Data for 1 hr are discussed to illustrate difficulties. One particular smooth crossing shows that complicated microstructure can occur in times less than 1 min. Averaging over long times may eliminate essential information. Inspection of the magnetic field data at the highest resolution, however, shows that the direction of the plasma sheet flows and the sense of Bz across the neutral sheet do not always agree with the reconnection models. Rather, they indicate that the low latitude boundary layer may play a significant role in the dynamics of the magnetotail. ESA

N87-16694 Science Applications International Corp., McLean, Va.
DOUBLE LAYERS IN EXPERIMENTS, SIMULATIONS, AND SPACE c75
Robert A. Smith *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 327-350 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Laboratory experiments and numerical simulations of plasma double layers are reviewed. Features peculiar to experimental or numerical investigation, and results which have general implications for double layers in space are emphasized. Dynamics, structure, and stability of double layers are discussed, considering the effects of boundary conditions (trapped particles, Bohm conditions, and applied potentials), waves and turbulence, collisions, and volume ionization. ESA

N87-16695 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
NUMERICAL SIMULATIONS OF CURRENT DRIVEN DOUBLE LAYERS c75
G. Chanteur *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 351-355 (For primary document see N87-16670 08-88)

Avail: CEPADUES-Editions, Toulouse, France

The formation of weak double layers by current driven instabilities is discussed. Results of periodic numerical simulations, particularly the dynamics of ion holes and their instability, as they play a major role in the formation of these weak double layers are reviewed. Consequences for particles in auroral conditions are examined. ESA

N87-16696* Iowa Univ., Iowa City.
ELECTRON ACCELERATION VIA KINETIC ALFVEN WAVES
C. K. Goertz *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 357-370 (For primary document see N87-16670 08-88)
(Grants NAGw-386; NsG-7632; NGL-16-001-043; NSF ATM-81-11126)
Avail: CEPADUES-Editions, Toulouse, France

Kinetic effects on obliquely propagating shear Alfven waves are reviewed. The wave becomes dispersive and carries a significant parallel electric field. The polarization and dispersion of these waves are discussed, showing that electrons can be effectively accelerated along field lines by these waves. Nonlinear effects such as solitary waves, nonlinear damping due to current-driven instabilities, and anomalous resistivity are treated. Observations of electric and magnetic field perturbations on auroral field lines which seem to be related to these waves are studied. Evidence for the existence of these kinetic Alfven waves is not firm. ESA

N87-16697 Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THE AURORAL ALFVEN WAVE TURBULENCE AS A SOURCE OF THE PARTICLE ACCELERATION c75
A. S. Volokitin and E. M. Dubinin *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 371-375 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

It is proposed that strong Alfven wave turbulence arising as a result of the modulation-type instability of large amplitude Alfven waves provides a mechanism for electron acceleration in the magnetosphere. This turbulence leads to the appearance of the short scale magnetic field disturbances and correspondingly strong field-aligned currents. Electrons are accelerated by parallel electric field arising due to anomalous instability in such structures. ESA

N87-16698 Imperial Coll. of Science and Technology, London (England).
THE EFFECT OF ALFVEN WAVES ON ENERGETIC PARTICLE ABSORPTION AT IO. c91
Andrew N. Wright and David J. Southwood *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 377-385 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The absorption of test-particles is studied analytically for Io. Io, being a conductor, perturbs the ambient E and B fields in and near the magnetic flux tube that is connected to it. The Shulz and Eviatar (1977) analysis is extended by including a complete dipole geometry; it is valid for all particles (not just the 90 deg pitch angle limit) and the satellite can assume any degree of conductivity. The effect of the perturbation varying in amplitude as it propagates through the Io torus is also taken into account. By considering the total energy surfaces of test-particles it is possible to understand how the different flow modes derived by Shulz and Eviatar arise. The theory developed also enables estimates of the energy range for each type of flow to be made. This is useful for studying particle distributions from Io's L-shell. Electron distribution near Io's flux tube reveals features expected from the theory. ESA

N87-16699 California Univ., Berkeley. Space Sciences Lab.
HEATING OF CUSP IONS DUE TO SOLAR WIND POPULATIONS c92
I. Roth and M. K. Hudson *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric System 1986 p 387-394 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Heating of ionospheric ions is investigated as an intermixing process of magnetosheath and ionospheric plasma populations in the cusp. Downflowing ion distributions originating in the solar wind are shown to be unstable to lower hybrid waves for perpendicular propagation and at the helium gyrofrequency at highly oblique angles, with additional lower frequency modes generated in a multispecies plasma. The helium mode is responsible for oxygen heating, while the lower hybrid and hydrogen Bernstein modes contribute to the predominant hydrogen heating. Inclusion of superthermal (and background) electron dynamics determines a range of unstable propagation angles perpendicular to the magnetic field of order + or - 15 deg for Mh/Me = 50, and narrower for real mass ratios. It is concluded that measured ion distributions have sufficient energy flux to account for inferred conic heating via the mechanism studied. ESA

N87-16700 Sussex Univ., Brighton (England).
VELOCITY RESONANT WAVE-PARTICLE INTERACTIONS c46
M. P. Gough, P. J. Christiansen, and A. J. Norris *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 395-402 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Auroral and magnetospheric studies of wave-particle interactions are reviewed. Direct measurement of the auroral beam/ionospheric plasma interaction shows that auroral beam electrons provide energy for the growth of waves which in turn modify the overall distribution function of the beam and ionospheric plasma combined. The AMPTE particle correlator (SPACE) studied wave-particle interactions initialized by the AMPTE artificial comet release of barium in the solar wind. A beam-plasma interaction is clearly identified from the experimentally drawn wave dispersion relation. The SPACE studied electron heating in the Earth's bow shock. The shock potential generated electron beams present in the bow shock are identified as being responsible for the high frequency electrostatic wave component observed in shocks. ESA

N87-16701* California Univ., Berkeley. Space Sciences Lab.
THE ACCELERATION OF IONS AND ELECTRONS BY ELECTROMAGNETIC ION CYCLOTRON WAVES
M. Temerin and I. Roth *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 403-409 (For primary document see N87-16670 08-88)
(Grant NAG6-10; Contract N000-14-81-C-0006; Grant NSF ATM-84-45010)
Avail: CEPADUES-Editions, Toulouse, France

Test particle calculations of the interaction of electrons and ions with obliquely propagating electromagnetic ion cyclotron waves are presented. Such waves have frequencies below the ion cyclotron frequency. The test particle calculations show that field-aligned electrons can be accelerated parallel to the magnetic field by such waves and that ions can be accelerated perpendicular to the magnetic field to form ion conics. Ions can be accelerated much more effectively when the wave frequency is half the ion gyrofrequency. The results are applicable to acceleration of ions and electrons in the low-Beta plasma of the auroral zone. ESA

N87-16702 Chile Univ., Santiago. Dept. de Fisica.
ULTRALOW FREQUENCY (ULF) ION CYCLOTRON WAVES IN THE MAGNETOSPHERE c46
L. Gomberoff *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 411-414 (For primary document see N87-16670 08-88)
(Grant E-1742-8533)
Avail: CEPADUES-Editions, Toulouse, France

It is shown that the main effect of cold ions on proton-cyclotron instability is to shift the unstable spectrum. The maximum convective growth rate is approximately the same with or without cold

protons provided that the marginal mode is far from the maximum growth rate. If more than one cold species are present, the situation is more complicated but the basic mechanism is the same. ESA

N87-16703 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
LOW FREQUENCY ELECTROSTATIC TURBULENCE INDUCED BY ION CONICS IN PRESENCE OF COUNTERSTREAMING ELECTRONS c75
M. Malingre and R. Pottelette *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 415-422 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Instability of electrostatic waves induced near the lower hybrid frequency by the interaction of a plasma with an ion beam having a large velocity component perpendicular to the ambient magnetic field, in the presence of counterstreaming parallel electron beams is studied. Ion ringlike distributions can destabilize lower hybrid waves propagating obliquely with respect to the ambient magnetic field. The vectors of the waves are such that the parallel phase velocity of the waves is much greater than the thermal velocity of the background electrons and background ions, thus avoiding Landau damping due to the background particles. The structure of the waves depends on the velocity spread in the parallel direction. The additional presence of upward and downward field-aligned electrons typically of a few hundred eV, even of low density compared to the ion ring distribution, greatly modifies the growth rate of these waves. ESA

N87-16704 Ecole Polytechnique, Palaiseau (France). Centre de Physique Theorique.
RADIO EMISSIONS FROM PULSARS c93
Estelle Asseo *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 425-465 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Observations which reveal that pulsars radiate in the radio range periodic pulses of very high intensity, with remarkably short and stable periods are reviewed. The brightness temperatures, associated with the radio radiation, are extremely high. These features imply that pulsars are rotating neutron stars which contain a huge magnetic field and emit coherently in the radio domain. The radio pulses, which are detected only during a very small fraction of the period, suggest that the emissions can be related to the existence of a very narrow radio beam corotating with the neutron star. However the observations do not point to any particular location for the source of the radio radiation. Sites proposed are the polar caps and the light cylinder regions. In these models, the growth of plasma instabilities is assumed to be at the origin of the coherence needed to account for the high level of radio emissions. ESA

N87-16705* Colorado Univ., Boulder. Dept. of Astrophysical, Planetary and Atmospheric Sciences.
RADIO EMISSION FROM BINARY STARS
George A. Dulk *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 467-476 (For primary document see N87-16670 08-88)
(Grants NsG-7297; NAGw-91)
Avail: CEPADUES-Editions, Toulouse, France

Radio emission from binary star systems; characteristics of the binary systems inferred from the radio observations; and the reasons for the activity are reviewed. Binary stars with two main sequence stars, with one normal star and a white dwarf, and those containing a neutron star or a black hole are described. Energy may be directly available as matter falls into the potential well of a compact object. Electromagnetic induction effects may occur due to relative motions of magnetic fields and matter. By enforcing rapid rotation, binaries can induce strong dynamo action and hence generate free energy in the form of intense, complex, evolving magnetic fields. Whatever the source of energy, the observations at radio and X-ray wavelengths demonstrate that electrons are accelerated to high energies (mildly relativistic and, ultrarelativistic). Observed or inferred radio brightness temperatures range up to 10 to the 15th power K or more, implying coherent emission for sources brighter than 10 billion K. ESA

N87-16706 Observatoire de Paris-Meudon (France).
COMPARATIVE STUDY OF PLANETARY RADIO EMISSIONS c93
F. Genova *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 477-495 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The observed properties of Earth, Jupiter, and Saturn nonthermal magnetospheric radio emissions, the position and morphology of their sources, and presence of energetic electrons, which are probably the energy source of the emissions, are compared. Theories of the generation of the emission, principally the cyclotron maser mechanism, are confronted with the observational constraints on the emission mechanism deduced from the comparative study of the emissions. ESA

N87-16707* Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
PLASMA WAVES AND CONTINUUM RADIATION IN PLANETARY MAGNETOSPHERES
W. S. Kurth *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 497-532 (For primary document see N87-16670 08-88)
(Grants NAGw-386; JPL-954013)
Avail: CEPADUES-Editions, Toulouse, France

Voyager data on whistler mode waves and electron cyclotron harmonic emissions are analyzed to understand the interaction of the waves with the dynamics of the electrons. The occurrence and characteristics of Jovian whistler mode chorus and the interactions with the plasma in and near the Io torus are emphasized. Bernstein waves, especially those near the upper hybrid or plasma frequency are discussed to provide insight into an important plasma diagnostic tool and to compare the relevant portions of the electron distribution function at Earth, Jupiter, and Saturn. The nonthermal continuum radiation common to the magnetospheres of Earth, Jupiter, and Saturn is considered. Because of the very low frequency of these radio waves and their close association with upper hybrid resonance emissions, continuum radiation is often associated more closely with the plasma wave spectrum of a planetary magnetosphere than with the planet's radio spectrum. ESA

N87-16708 Observatoire de Paris-Meudon (France).
THEORETICAL DETERMINATION OF THE SPECTRAL INTENSITY OF PLANETARY RADIO EMISSIONS c93
P. Zarka, D. LeQueau, and F. Genova *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 533-543 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Maser synchrotron instability generation of auroral kilometric radiation (AKR) and of the nonthermal radio emissions from other magnetized planets and from flaring stars is discussed. A fully inhomogeneous theory of the instability process, taking into account the strong vertical magnetic field gradient, is developed. Since the inhomogeneity also quenches the usual saturation mechanism, AKR spectral intensity is determined by solving the inhomogeneous linear transfer equation. The computed AKR fluxes are consistent with those observed, if nonthermal features of the electron distribution function are present at sufficient energies. It is shown that no nonlinear effect occurs for weak AKR events, and that the saturation level due to a trapping-type mechanism corresponds well to the maximum observed AKR spectral intensity. In the case of the jovian decameter (DAM) radio emission, nonlinear saturation processes limit the emission flux. This permits estimation of the DAM spectral density, which is in good agreement with the observations. ESA

N87-16709* California Univ., Los Angeles.
RELATIVISTIC DISPERSION MODIFICATIONS TO THE CYCLO-

TRON MASER THEORY OF PLANETARY RADIO EMISSIONS
P. L. Pritchett and R. J. Strangeway *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 545-550 (For primary document see N87-16670 08-88)
(Grants NAGw-78; NSF ATM-82-18746; NSF PHY-83-04641)
Avail: CEPADUES-Editions, Toulouse, France

The effects of relativistic dispersion on the electron-cyclotron maser instability are investigated by linear theory, electromagnetic particle simulation, and quasilinear theory. When vsq/csq greater than or = omega pesq/Omega sq for the energetic electrons, the instability is localized just below k c/Omega e = 1, and the growth rate is strongly peaked for emission at 90 deg to the magnetic field. Saturation of the instability is due to perpendicular diffusion in momentum space, and the saturation level increases as omega pe/Omega e is decreased. Applications of the maser instability to the generation of the Earth's auroral kilometric radiation are discussed. ESA

N87-16710* California Univ., Los Angeles. inst. of Geophysics and Planetary Physics.
ELECTRON-CYCLOTRON MASER EMISSION FROM THE PLANETS AND THE STARS
R. M. Winglee and G. A. Dulk *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 551-554 (For primary document see N87-16670 08-88)
(Grants NAGw-91; NAGw-78)
Avail: CEPADUES-Editions, Toulouse, France

Auroral kilometric radiation (AKR), Jupiter's decametric radio emission, microwave spike bursts from the Sun, and related bursts from flare stars and close binaries are discussed. Although all of these are produced by the same instability, the plasma conditions in the source regions differ; for the planets the ratio of the plasma frequency to the electron-cyclotron frequency is less than 1, whereas for the Sun and stars it is greater than or = 1. It is shown that as the ratio increases the frequency of the emissions moves to higher harmonics of the electron-cyclotron frequency and the mode changes from electromagnetic to electrostatic. Implications for AKR, microwave spike bursts, and related bursts from the stars are discussed. ESA

N87-16711 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
FULLY RELATIVISTIC ELECTRON MASERS: A MECHANISM FOR STELLAR RADIO BURSTS c93
D. LeQueau, P. Louarn, and A. Roux *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 555-562 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

It is advocated that stellar X mode emission could be due to fully relativistic electrons (with energies lying in the 500 keV-1 MeV range), and that the growth rate is linked to higher harmonics resonant terms. This explains why the maser synchrotron instability (MSI) process could be efficient, even though the ratio omega P/omega c is not small, a situation which can be encountered in the stellar environment. Moreover, for the MSI to be active, it is no longer essential that the distribution function exhibit true loss-cone features. ESA

N87-16712 Cambridge Univ. (England). Cavendish Lab.
FULL WAVE CALCULATIONS OF RADIO WINDOWS AND THEIR RELEVANCE TO THE THEORY OF PRODUCTION OF PLANETARY NONTHERMAL CONTINUUM RADIATION c93
K. G. Budden and D. Jones *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 563-580 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

Criticisms of the linear conversion theory that predicts that upper hybrid waves and density gradients play a prominent role in the production of nonthermal continuum radiation are addressed. One criticism is that simultaneous measurements on GEOS and ISEE disprove that beaming was occurring. Another is that the limited dimensions of the radio window make it an inefficient avenue for mode conversion. It is also claimed that the theory cannot explain X-mode continuum which may occasionally coexist with O-mode continuum. It is shown that the GEOS-ISEE measurements are consistent with radiation from the magnetopause rather than the plasmapause. Full-wave calculations using density gradients observed by spacecraft suggest that the window dimensions are much larger than reported. It is found that X-mode waves are also generated, at a considerably lower intensity than the O-mode for plasmapause sources, but possibly of approximately equal intensity at the magnetopause. Implications for analogous radiations at Jupiter and Saturn are summarized. ESA

N87-16713 Centre National de la Recherche Scientifique, Orleans (France).
MAIN CHARACTERISTICS OF HISS OBSERVED BY GEOS 1 c90
M. Parrot and F. Lefeuvre *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 581-592 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The propagation characteristics of the most intense hiss events observed on GEOS-1 within and outside of the plasmasphere were determined using a wave distribution function analysis. Statistical distributions of the wave energy, with respect to the azimuthal angle, phi, and to the polar angle were established. It is shown that the wave energy is generally uniformly distributed in phi values within the equatorial region whereas it is concentrated into the meridional plane at higher magnetic latitudes. In the same way, there is a quasi-uniform distribution in theta values in the equatorial regions and a concentration around theta g at the higher magnetic latitudes. It is concluded that the generation mechanisms based on an amplification in one pass of the wave in the source region are more likely than generation based on amplifications in several passes; that waves are amplified at large theta angles as well as at theta = 0 deg; and that source regions exist on both side of the plasmapause. ESA

N87-16714 Centre National de la Recherche Scientifique, Orleans (France).
CORRELATIONS BETWEEN WIDEBAND FREQUENCY WAVES AND ELECTRON/ION FLUXES IN THE EARTH MAGNETOSPHERE c46
C. Beghin, J. M. Bosqued, J. L. Rauch, F. Lefeuvre, and M. Parrot *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 593-611 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

High latitude satellite results showing the correlation between radio frequency waves (100 kHz to 2 MHz) usually called radio frequency auroral hiss, low energy electron fluxes, ELF/VLF turbulence and, in the cusp region, the proton fluxes are presented. Evidence of a strong coupling between electromagnetic emissions, both in the whistler and in the Z modes, and electrostatic emissions near fp is shown. The waves are thought to be generated by a coherent Cerenkov emission mechanism. But the remarkably high intensity of these emissions, the evidence of electrostatic-electromagnetic wave coupling, the presence of ELF/VLF turbulence, and availability of coordinated measurements of the plasma parameters, should be considered in improvements of this theory, to account for the observations. ESA

N87-16715 Bangalore Univ. (India). Dept. of Physics.
STUDY OF GENERATION AND PROBING POTENTIALITY OF WHISTLERS IN EARTH AND VENUS c90
R. P. Singh, I. M. L. Das, and R. N. Singh *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 613-622 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The similarity theory of Golitsyn and Steklov (1973) is used to compare features of planetary atmospheres. Cloud features show that the lightning process is the main source of low frequency electromagnetic wave generation on Earth and Venus. It is shown that in the case of nonmagnetic planet Venus, the lightning

generated signals, unlike Earth, are mostly trapped in the ionopause-Venus waveguide and propagate round Venus by multiple reflections. It is shown that the VLF waves incident at grazing angles may propagate in the whistler mode whose typical trajectory is along the Venus ionopause. Propagation characteristics such as dispersion and propagation time are similar to those applicable to whistler studies in Earth's atmosphere. It is shown that the whistler mode waves are very useful for probing the Venus ionosphere whereas in the case of Earth and Jupiter whistlers prove useful in probing the magnetospheres. ESA

N87-16716 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE PLASMA AND WAVE EXPERIMENT ON VEGA-1 AND VEGA-2 c75
R. Grard, H. Arends, C. Beghin, J. Bouman, A. Butler, P. Fergeau, V. Formisano, J. Heida, K. Hjortnaes, J.-F. Karczewski et al *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 623-630 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

A Vega spacecraft instrument which explores the electrostatic and electromagnetic wave spectra with a dipolar probe from dc up to 300 kHz and measures the plasma density and temperature with a set of two Langmuir probes is presented. The primary objectives of the experiment are: to measure the density of the solar wind just before it is influenced by cometary constituents, thereby establishing a reference for understanding the subsequent solar wind-comet interaction; to observe the mass loading of the solar wind by cometary ions either directly or through the associated wave instabilities; to obtain plasma density and temperature profiles, as well as wave frequency spectra during the cometary transit; and to search for the signature of collision-free shocks and contact surface. ESA

N87-16717 Sussex Univ., Brighton (England). School of Mathematical and Physical Sciences.
OBSERVATIONS OF PLASMA WAVES DETECTED AT THE UKS SPACECRAFT ASSOCIATED WITH AMPTE SOLAR WIND ION RELEASES c75
P. J. Christiansen, M. P. Gouch, A. J. Norris, A. G. Darbyshire, L. J. C. Woolliscroft, C. P. Chaloner, and D. S. Hall *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 631-639 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

The solar wind releases of lithium and barium ions, made as part of the AMPTE mission, were used to study processes which take place at planetary magnetospheric boundaries. The UKS spacecraft was close to the Ion Release Module for these experiments. Data from the UKS wave and electron experiments are presented. The results, together with those of other experiments on UKS and IRM, allow a model of the wave and particle interaction regions to be produced. This shows the existence of a region of extremely strong wave generation in the compressed magnetic field on the sunwards side of the released ions, together with significant electron heating. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N87-16718 Texas Univ., Austin.
A STUDY OF THE ECLIPSES OF CATACLYSMIC VARIABLES Ph.D. Thesis
Er-Ho Zhang 1986 229 p
Avail: Univ. Microfilms Order No. DA8618600

The catalysmic variables (CV's) are all close binary stars in which a secondary star fills its Roche lobe and transfers mass to its white dwarf companion. The transferred mass forms an accretion disk--or ring--around the white dwarf. Reliable determinations of the masses of the two component stars, the distributions of temperature and brightness across the disk, and other parameters, are necessary to understand both the CV's and the accretion processes, but they are extremely difficult to measure. The best way to obtain this data is to observe eclipsing CV's. A computer program was developed to synthesize light curves of eclipsing CV's using the most realistic model built so far to analyze the eclipses of CV's. A statistical method has also been developed to perform a complete error analysis of the results of the numerical studies. High-speed, multi-color photometry of three eclipsing CV's: HT Cas, U Gem and AC Cnc was obtained. Using the program to analyze the observed light curves, the orbital inclination, the sizes, masses and temperatures of the two component stars, and the temperature distribution across the disk were derived for each system. Using the derived parameters, the evolutionary state of the secondary, the mass transfer rate, the distance of the system, and the structure of its disk were investigated for each system. The secondary stars in the three systems are very close to the main-sequence. The derived mass transfer rates and structures of the accretion disks in the three systems are in agreement with the current theories of the instabilities in accretion disks. Author

N87-16719*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
X-RAY ASTRONOMY EXPERIMENTS FROM SOUNDING ROCKETS Final Technical Report
Saul Rappaport 30 Jan. 1987 36 p
(Grant NgR22-009-730)
(NASA-CR-180112; NAS 1.26:180112) Avail: NTIS HC A03/MF A01 CSCL 03A

During the past fourteen years, the M.I.T. X-ray Astronomy sounding rocket group has designed, fabricated, and flown five different scientific sounding rocket payloads. These experiment payloads were launched on a total of twelve sounding rocket flights of which only one failed because of rocket problems. Eight of these flights yielded astronomical data that resulted in a total of twelve publications. The bulk of this research was supported by NASA Grant NGR 22-009-730 X-Ray Astronomy Experiments Sounding Rockets. The fifth and final experiment payload conceived and built under this Grant (the Wide Field Soft X-ray Camera: WFSXC) served as the prototype for the British Wide Field Camera (WFC) experiment to be launched on the ROSAT mission. The five experiment payloads and the results obtained from these experiments are briefly described. In the case of the WFSXC, which served principally as an engineering prototype for a major space mission, a number of papers written by British collaborators which describe the ROSAT Wide Field Camera are presented.
Author

N87-16720*# Lowell Observatory, Flagstaff, Ariz. Planetary Research Center.
OCCULTATION STUDIES OF THE SOLAR SYSTEM Semiannual Status Report, 1 Jul. - 31 Dec. 1986
Robert L. Millis 18 Feb. 1987 4 p
(Grant NsG-7603)
(NASA-CR-180143; NAS 1.26:180143; SASR-13) Avail: NTIS HC A02/MF A01 CSCL 03A

The planetary occultation program began at Lowell Observatory in 1973 with a worldwide campaign to observe mutual occultations and eclipses of the Galilean Satellites. Then the temperature profile of the Martian atmosphere was measured from data taken during the occultation of epsilon Geminorum, the Rings of Uranus were discovered as they occulted SAO 158687, and the dimensions of Pallas were measured when that minor planet occulted SAO 85009. In 1979 the present grant was initiated, providing funds for portable photometric instrumentation used to observe occultations by asteroids as well as by Uranus and Neptune. Software for predicting occultations of catalog stars by asteroids, planets, and comets was written in 1983. Lowell currently provides most of the available predictions for asteroid occultations. Realizing in 1983 that the lack of a high-quality astrometric telescope dedicated to occultation

work was limiting progress, an 18-inch, F/8 lens was acquired and adapted to an existing mounting at Lowell. Although acquisition of the lens and implementation of the new telescope has been accomplished primarily with non-grant funds, the instrument makes a major contribution to occultation research. Author

N87-16721# Tufts Univ., Medford, Mass. Dept. of Physics and Astronomy.
RADIO WAVELENGTH OBSERVATIONS OF MAGNETIC FIELDS ON ACTIVE DWARF-m, RM CVN AND MAGNETICS STARS
Kenneth R. Lang 1986 5 p
(Contract N00014-86-K-0068; Grant AF-AFOSR-0019-83)
(AD-A171985) Avail: NTIS HC A02/MF A01 CSCL 03/2

The dwarf M stars YZ Canis Minoris and AD Leonis exhibit narrow band, slowly varying (hours) microwave emission that cannot be explained by conventional thermal radiation mechanisms. The dwarf M stars AD Leonis and Wolf 424 emit rapid spikes whose high brightness temperatures similarly require a nonthermal radiation process which could result from coherent mechanisms such as an electron cyclotron maser or coherent plasma radiation. If the electron cyclotron maser emits at the second or third harmonic of the gyrofrequency, the coronal magnetic field strength H = 250 C or 167 G and constraints on the plasma frequency imply an electron density of N sub e = 6 x 10 to the 9th power/cc. Coherent plasma radiation requires similar values of electron density but much weaker magnetic fields. Radio spikes from AD Leonis and Wolf 424 have rise times tau sub R less than 5 ms, indicating a linear size of L less than 1.5 x 10 to the 8th power cm, or less than 0.005 of the stellar radius. Although Ap magnetic stars have strong dipole magnetic fields, they exhibit no detectable gyroresonant radiation, suggesting that these stars do not have hot, dense coronae. The binary RS CVn star UX Arietis exhibits variable emission at 6 cm wavelength on time scales ranging from 30 s to more than one hour. The shortest variation implies a linear size much less than that of the halo observed by VLBI techniques, and most probably sizes smaller than those of the component stars. The observed variations might be due to absorption by a thermal plasma located between the stars. GRA

N87-16722# Air Force Geophysics Lab., Hanscom AFB, Mass.
STRUCTURE OF THE EXTENDED EMISSION IN THE INFRARED CELESTIAL BACKGROUND
Stephan D. Price 30 Sep. 1986 16 p
(AD-A172609; AFGL-TR-86-0195) Avail: NTIS HC A02/MF A01 CSCL 17/5

The extended emission in the infrared celestial backgrcund may be divided into three main components: the zodiacal background, the large discrete sources in the galaxy and the interstellar dust. The zodiacal background is due to the thermal reradiation of sunlight absorbed by the dust in the solar system. An earth orbiting infrared telescope will detect the diffuse emission from this dust in all directions with maximum intensity lying roughly along the ecliptic plane where the density of dust is highest. Structure with scale lengths of 10 deg have been measured in both the visual and infrared; finer structure has been detected in the infrared by the Infrared Astronomy Satellite. H II regions, areas of ionized gas mixed with and surrounded by dust, are the brightest discrete objects in the galaxy in the long wavelength infrared re-emitted in the infrared with a range of temperatures characteristic of the thermal equilibrium for the surroundings of the dust. The emission from the interstellar dust produces a filimentary structured background, the infrared cirrus. The observed far infrared color temperature of about 20-35K for the cirrus is consistent with emission form graphite and silicate grains which absorb the interstellar radiation field. The much larger LWIR color temperature is likely due to a greater abundance of sub-micron particles in the interstellar medium and, perhaps, from band emission due to polycyclic aromatic hydrocarbons. GRA

N87-16723# Maryland Univ., College Park. Dept. of Physics and Astronomy.
ON TWO COLOR AND CCD METHODS FOR THE DETERMINATION OF ASTRONOMIC POSITION Final Report, 18 Sep. 1981 - 31 Dec. 1984
Douglas G. Currie and Dennis D. Wellnitz 14 Mar. 1986 133 p
(AD-A174088; AFGL-TR-86-0111) Avail: NTIS HC A07/MF A01 CSCL 03/1

The long range objective of the investigations in the area of astroposition consists of the application of new electrooptical techniques to obtain increased precision, accuracy, and effectiveness in the field operation of an astroposition instrument. The topics which are discussed in this paper relate to a portion of this program, that is, the design, construction, and use of the Two Color Refractometer (TCR). The purpose of this investigation of the TCR is to provide a series of corrections to the astroposition field measurements which would be made by a T-4 Theodolite or by an Astrolabe. These corrections address the errors caused by the refraction in the atmosphere. The corrections must be applied to the measured star coordinates in order to establish a more accurate value for the astronomic longitude and latitude. GRA

N87-16724# Environmental Research Inst. of Michigan, Ann Arbor.
DIFFRACTION-LIMITED IMAGING OF SPACE OBJECTS III Final Report, 1 Mar. 1982 - 31 Oct. 1985
James R. Fienup and Christopher C. Wackerman Oct. 1986 227 p
(Contract F49620-82-K-0018)
(AD-A174100; ERIM-161900-20-F; AFOSR-86-2109TR) Avail: NTIS HC A11/MF A01 CSCL 14/5

This report investigate methods for obtaining diffraction limited images of space objects, despite the turbulent atmosphere, by reconstructing images from data provided by optical interferometers (particularly stellar speckle interferometry). Major accomplishments include the following: (1) A new closed form recursive algorithm was invented for reconstructing sampled objects having latent reference points. (2) Improvements in the iterative Fourier transform algorithm were devised, solving the stagnation problems of stripes and of simultaneous twin images. (3) Uniqueness of the reconstructed image was demonstrated empirically. (4) Reconstruction of complex valued objects was shown to to be possible. (5) The Hayes Quatieri recursive algorithm was shown to suffer from a uniqueness problem, and that algorithm was generalized. (6) An improved method for estimating the object's Fourier modulus from stellar speckle interferometry data was devised. GRA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N87-16725 Maryland Univ., College Park.
THE EFFECT OF DUST IN THE EMISSION LINE GAS OF SEYFERT 2 NUCLEI Ph.D. Thesis
Steven Baker Kraemer 1985 150 p
Avail: Univ. Microfilms Order No. DA8608821

The results of photoionization models of the emission line spectra of a Type 2 Seyfert galaxy are presented using a computer code which was adapted from a program written by J. P. Harrington. The effect of dust within the emission line gas on the transfer of line radiation, and the contribution of the hot dust to the infrared continuum are examined within the code. The results were compared to the observed properties of the luminous Seyfert 2 galaxy, Markarian 3 (MK 3), which was extensively observed, from radio to X-ray wavelengths. The results of the models give a close enough fit to the observed properties of MK 3 to state, with reasonable certainty, that the emission line gas is photoionized and that the dust within the clouds is producing the infrared continuum. The calculated effects of dust on the line transfer agree well with the predictions from previous studies. Finally, the models predict the existence of a component of highly ionized, dense (n is greater than or equal to 10 to the 9.5 power/cu cm), dust-free gas within the nucleus of MK 3, from which ultraviolet resonance lines arise. Dissert. Abstr.

N87-16726 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
BINARY STARS
Frank Verbunt and Piet Hut (Institute for Advanced Study, Princeton, N.J.) Jun. 1986 28 p Submitted for publication
(MPE-Preprint-56; ETN-87-98870) Copyright. Avail: Issuing Activity

The theory and observations of time dependent stellar mass accretion disks, and the globular cluster population of X-ray binaries are discussed. For individual titles, see N87-16727 through N87-16728.

N87-16727 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THEORY AND OBSERVATIONS OF TIME-DEPENDENT ACCRETION DISKS
Frank Verbunt *In its* Binary Stars Jun. 1986 15 p Presented at Workshop on Physics of Accretion onto Compact Objects, Tenerife, Spain, 21-25 Apr. 1986 Submitted for publication (For primary document see N87-16726 08-90)
Copyright. Avail: Issuing Activity

The theory of time-dependent accretion disks is reviewed. Dwarf nova outbursts are discussed. Predictions of the disk instability and the red-star instability models are compared with the observational evidence. It is found that both models have their successes and failures. In general, optical observations are in better agreement with the disk instability model, ultraviolet observations with the red-star instability. ESA

N87-16728 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE GLOBULAR CLUSTER POPULATION OF X-RAY BINARIES
Frank Verbunt and Piet Hut (Institute for Advanced Study, Princeton, N.J.) *In its* Binary Stars Jun. 1986 10 p Presented at 125th IAU Symposium on the Origin and Evolution of Neutron Stars, Nanjing, China, 26-30 May 1986 Submitted for publication (For primary document see N87-16726 08-90)
Copyright. Avail: Issuing Activity

Formation mechanisms for low-mass X-ray binaries in globular clusters are discussed. Tidal capture in close two-body encounters between neutron and main-sequence stars is applied to the clusters of our galaxy. The observed number of X-ray sources in these can be explained if the birth velocities of neutron stars are higher than estimated from velocity measurements of radiopulsars, or if the initial mass function steepens at high masses. A statistical test on the distribution of X-ray sources with respect to the number of close encounters in globular clusters reveals agreement between the tidal capture theory and observation, apart from the presence of low-mass X-ray binaries in clusters with a very low encounter rate: Ter 1, Ter 2, Gr 1, and NGC 6712. Observations of EXOSAT indicate that dim globular cluster sources may be less luminous than hitherto assumed, and support the view that the brighter dim sources may be soft X-ray transients in quiescence. ESA

N87-16729*# San Diego State Univ., Calif. Dept. of Electrical and Computer Engineering.
PHOTOABSORPTION AND PHOTODISSOCIATION OF MOLECULES IMPORTANT IN THE INTERSTELLAR MEDIUM Annual Report, 15 May 1986 - 14 Jan. 1987
Long C. Lee and Masako Suto 30 Jan. 1987 52 p
(Grant NAGw-319)
(NASA-CR-180101; NAS 1.26:180101) Avail: NTIS HC A04/MF A01 CSCL 03B

A windowless apparatus was constructed and used to measure the photoabsorption and fluorescence cross sections of molecules in the extreme ultraviolet region. Photoabsorption and fluorescence cross sections of H2O, D2O, H2S, D2s, and Co were measured in the 50 to 200 nm region. These quantitative data are currently needed for the determination of the formulation and destruction rates of molecules in the interstellar medium. B.G.

N87-16730# Florida Univ., Gainesville. Space Astronomy Lab.
INTERPLANETARY DUST AND THE VISIBLE/INFRARED SKY BACKGROUND RADIATION Final Report, 1 Apr. 1983 - 30 Sep. 1984
Jerry L. Weinberg 7 Jul. 1986 21 p
(Grant AF-AFOSR-0107-83)
(AD-A171944; AFOSR-86-0687TR) Avail: NTIS HC A02/MF A01 CSCL 03/1

A multidisciplinary approach is developed to provide information on the optical and physical properties of interplanetary dust, its location in space, its origin and dynamics, and its contribution to the astronomical background radiation in the infrared. This approach makes use of ground-based, Earth-orbital, and deep-space probe observations of zodiacal light; development and use of inversion techniques to derive information on particle properties and distribution from zodiacal light observations; analysis of comet tail observations; theoretical calculations and laboratory measurements of scattering by spheroids, cylinders and irregular particles; studies of interplanetary dust dynamics. GRA

N87-16731# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
G-DWARFS, WHITE DWARFS AND THE LOCAL DARK MATTER
K. A. Olive Jan. 1986 30 p
(Contract DE-AC02-83ER-40105)
(DE86-014800; DOE/ER-40105/547) Avail: NTIS HC A03/MF A01

The obseved paucity of low metallicity stars (the G-dwarf problem), the observed paucity of low luminosity white dwarfs and the apparent overabundance of matter in the solar neighborhood are discussed in a single context. In particular, bimodal models of star formation with enhanced cooling of low luminosity white dwarfs may be able to simply solve the G-dwarf problem as well as the local dark matter problem without the overproduction of observable white dwarfs. Constraints from galactic chemical evolution are also discussed. DOE

N87-16732# Colorado Univ., Boulder.
REVIEW OF THE ULTRAVIOLET STUDIES OF GALACTIC NOVAE
S. Starrfield 1986 25 p Presented at the New Insights in Astrophysics Conference, London, England, 14 Jul. 1986 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE86-015347; LA-UR-86-2642; CONF-860772-1) Avail: NTIS HC A02/MF A01

The ultraviolet studies of galactic novae both in outburst and also in quiescence have provided new and fundamental data on these exploding stars. As a direct result of the IUE spectral studies, we have identified a new class of novae in which the outburst occurs on an ONeMg white dwarf. We have also been able to determine ejected masses, elemental abundances, and ultraviolet light curves for a wide variety of nova outbursts. DOE

N87-16672 Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
MAGNETOSPHERES OF ACCRETING COMPACT OBJECTS IN BINARY SYSTEMS
J. J. Aly *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p25-36 In FRENCH; ENGLISH summary (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16673 Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
MAGNETOSPHERES OF PULSARS
Michel F. Curtis *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 37-44
(For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16675 Oesterreichische Akademie der Wissenschaften, Vienna. Space Research Inst.
ANALYTICAL MODELS OF PLANETARY MAGNETOSPHERES
H. K. Biernat, N. I. Koemle, H. I. M. Lichtenegger, and H. O. Rucker *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 77-80 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16678* Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.
ENERGETIC IONS UPSTREAM OF PLANETARY BOW SHOCKS: FERMI ACCELERATION OR LEAKAGE
S. M. Krimigis *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 99-124 Sponsored in part by NASA (For primary document see N87-16670 08-88)
(Contract N000-24-85-C-5301)
Avail: CEPADUES-Editions, Toulouse, France CSCL 03B

N87-16679 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
TRANSFER THROUGH MAGNETOPAUSES
Goetz Paschmann *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 125-129 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16684 Rice Univ., Houston, Tex. Center for Space Physics.
CONVECTION IN PLANETARY MAGNETOSPHERES
T. W. Hill *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 201-215 (For primary document see N87-16670 08-88)
(Grants NSF ATM-83-06772; NSF ATM-83-11146)
Avail: CEPADUES-Editions, Toulouse, France

N87-16685 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
EQUILIBRIA OF PLASMA RESERVOIRS IN PLANETARY MAGNETOSPHERES
G. Caudal and M. Blanc *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 217-244 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16713 Centre National de la Recherche Scientifique, Orleans (France).
MAIN CHARACTERISTICS OF HISS OBSERVED BY GEOS 1
M. Parrot and F. Lefeuvre *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 581-592 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16715 Bangalore Univ. (India). Dept. of Physics.
STUDY OF GENERATION AND PROBING POTENTIALITY OF WHISTLERS IN EARTH AND VENUS
R. P. Singh, I. M. L. Das, and R. N. Singh *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 613-622 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16754*# Alabama Univ., Huntsville. Dept. of Physics and Astronomy.
HOW ARE QUASARS FUELED? SIMULATING INTERSTELLAR GAS IN TIDALLY DISTURBED GALAXIES
Gene G. Byrd *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N87-16733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON SEASONAL VARIATIONS OF MARS' GRAVITATIONAL FIELD
B. Fong Chao and David P. Rubincam Jan. 1987 17 p
(NASA-TM-87807; Rept-87B0134; NAS 1.15:87807) Avail: NTIS HC A02/MF A01 CSCL 03B

A great quantity of CO2 is exchanged between the Martian atmosphere and polar caps in the course of a Martian year. This exchange occurs in seasonal cycles: CO2 condenses to form the polar caps in winter and sublimes into the atmosphere in summer. The mass involved is about 25% of the total mass of the Martian atmosphere. This paper studies the effects of the CO2 mass redistribution on the Mars' gravitational field. Two mechanisms are examined: (1) the waxing and waning of solid CO2 in the polar caps, and (2) the geographical distribution of gaseous CO2 in the atmosphere. The maximum changes produced by (1) in the low-degree zonal J sub l harmonics in the Mars gravitational field are found to be as much as 7.5 x 10 to the-9 power for J sub 2 (corresponding to 1.1 cm change in the geoid), and about half as much for J sub 3. The effect of (2) on some most prominent low-degree harmonics (for l =1-3) in the effective topography (defined as the departure of the true topography from the geoid) is also evaluated. Their magnitudes are large by Earth standards. Whether they can be observed by the upcoming Mars Observer is still uncertain. Author

N87-16734# Naval Postgraduate School, Monterey, Calif.
THE ATMOSPHERE AROUND SATURN'S RINGS: A STUDY OF THE PROBABILITY OF COLLISION BETWEEN RING PARTICLES AND ATMOSPHERIC MOLECULES M.S. Thesis
David F. Bedey Jun. 1986 101 p
(AD-A171687) Avail: NTIS HC A06/MF A01 CSCL 03/2

An analytic model is developed to allow derivation of the probability that a molecule in the atmosphere of Saturn's rings collides with at least one ring particle when traversing the ring plane. The resulting expression involves details of the molecule's trajectory, including the velocity of the molecule relative to ring particles; thus, the theory is compatible with recently developed ballistic-transport computer models used in the analysis of the rings. The collision theory is applied to the case of a low energy, isotropic molecular production process to make inferences on the spatial extent of the ring atmosphere associated with such a source. The high frequency of collisions expected for the atmosphere in the vicinity of the A and B rings suggests a toroidal atmosphere. GRA

N87-16735# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
INTERPRETATION OF ELECTROSTATIC NOISE OBSERVED BY VOYAGER 1 IN TITAN'S WAKE Progress Report
T. Z. Ma and D. A. Gurnett Jun. 1986 44 p
(Contract N00014-85-K-0404)
(AD-A173996; U-OF-IOWA-86-26) Avail: NTIS HC A03/MF A01 CSCL 03/2

During the Voyager 1 spacecraft flyby of Titan on November 12, 1980, an intense broadband low frequency electric field noise was observed in the inbound wake. This so-called sheath noise is believed to be generated by an ion beam-plasma interaction between the ions in the corotational Saturnian magnetospheric plasma and nearly stationary plasma created by the ionization of Titan's atmosphere. The analysis is based on the information from Voyager 1 and reasonable assumptions. The results agree quite well with the observation. The analysis shows that the instability only occurs where the density of the corotational ions is

comparable to the density of ions originating from Titan's atmosphere. The growth rate is high enough to generate the observed noise, and the calculated and observed frequency ranges are in good agreement. GRA

N87-16686* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATURN: A UNIQUE MAGNETOSPHERE/IONOSPHERE/RING INTERACTION
J. E. P. Converney *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 245-251 Sponsored by NASA (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France CSCL 03B

N87-16687 California Univ., Los Angeles.
PLASMA COROTATION IN THE JOVIAN AND KRONIAN MAGNETOSPHERES
A. Eviatar, J. D. Richardson (Massachusetts Inst. of Tech., Cambridge.), and R. L. McNutt, Jr. *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 253-258 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16688 Nagoya Univ. (Japan).
INTERPLANETARY MAGNETIC FIELD (IMF) CONTROL AND CONVECTION IN THE JOVIAN MAGNETOSPHERE
A. Nishida and K. Maezawa *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 259-262 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16698 Imperial Coll. of Science and Technology, London (England).
THE EFFECT OF ALFVEN WAVES ON ENERGETIC PARTICLE ABSORPTION AT IO.
Andrew N. Wright and David J. Southwood *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 377-385 Sponsored by UK Science and Engineering Research Council (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N87-16736 Florida Univ., Gainesville.
DYNAMICS OF INTERPLANETARY DUST IN THE F CORONA Ph.D. Thesis
Edwin T. Rusk 1986 339 p
Avail: Univ. Microfilms Order No. DA8618674

The dynamical mechanisms in interplanetary space and in the F corona were studied using numerical simulations. An expression for the radiation pressure force due to a rotating spherical source of radiation was derived. Also, expressions relating the variation in inclination and the longitude of the ascending node to the solar magnetic field were derived. The latter are based on the spherical source surface model of the solar magnetic field. Simulation of particles released during perihelion passages of comet Encke show that cometary particles have lifetimes shorter than the lifetime calculated by Wyatt and Whipple in 1950. These simulations also resulted in higher eccentricities and a definite alignment of the particles' aphelia toward a direction 20 deg. east of the vernal equinox. An expression relating the size of a planet's zone of influence to perturbations on particles in solar orbits based on the closest approach between the planet and the particle show that the expression for the size of a planet's zone of influence is not singular, but varies with the particular orbital element which is being studied. Simulations of the interaction of the Lorentz force in the F corona, based on observed solar magnetic field values, result in a spreading of the inclinations of particles in circumsolar orbits. This result, along with a reevaluation of recent observations of the F corona, leads to the conclusion that the shape of the circumsolar dust cloud cannot be a ring, but must be a wide band or a spherical shell. Dissert. Abstr.

N87-16737# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DEVELOPMENT OF A CCD BASED SOLAR SPECKLE IMAGING SYSTEM Final Report, 1 Mar. 1983 - 30 Sep. 1985
Peter Nisenson, Robert V. Stachnik, and Robert W. Noyes 3 Feb. 1986 27 p
(Contract F19628-83-K-0025)
(AD-A172219; AFGL-TR-86-0044-1) Avail: NTIS HC A03/MF A01 CSCL 03/2

A program to develop software and hardware for the purpose of obtaining high angular resolution images of the solar surface is described. The program included the procurement of a Charge Coupled Devices imaging system; an extensive laboratory and remote site testing of the camera system; the development of a software package for speckle image reconstruction which was eventually installed and tested at the Sacramento Peak Observatory; and experiments of the CCD system (coupled to an image intensifier) for low light level, narrow spectral band solar imaging. GRA

N87-16738*# Tufts Univ., Medford, Mass. Dept. of Physics.
SOLAR BURST PRECURSORS AND ENERGY BUILD UP AT MICROWAVE WAVELENGTHS
Kenneth R. Lang and Robert F. Willson 1986 5 p Submitted for publication
(Grant NAG5-501; Contract N00014-86-K-0068; Grant AF-AFOSR-0019-83)
(NASA-CR-179972; NAS 1.26:179972; AD-A171925) Avail: NTIS HC A02/MF A01 CSCL 03B

We summarize high-resolution microwave observations (VLA) of heating and magnetic triggering in coronal loops. Magnetic changes that precede solar eruptions on time scales of tens of minutes involve primarily emerging coronal loops and the interaction of two or more loops. Thermal cyclotron lines have been detected in coronal loops, suggesting the presence of hot current sheets that enhance emission from relatively thin layers of enhanced temperature and constant magnetic field. These current sheets may play a role in the excitation of solar bursts. A filament-associated source with a high brightness temperature and steep radiation spectrum occurs above a region of apparently weak photospheric field. This source might be attributed to currents that enhance coronal magnetic fields. Compact (phi=5 sec) transient sources with lifetimes of 30 to 60 minutes have also been detected in regions of apparently weak photospheric field. We conclude by comparing VLA observations of coronal loops with simultaneous SMM-XRP observations. GRA

N87-16674 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC CONFIGURATIONS OF PLANETARY OBSTACLES
R. P. Lepping *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 45-75 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16699 California Univ., Berkeley. Space Sciences Lab.
HEATING OF CUSP IONS DUE TO SOLAR WIND POPULATIONS
I. Roth and M. K. Hudson *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric System 1986 p 387-394 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N87-16739# Washington Univ., Seattle. Space Sciences Div.
GEOMAGNETIC ACTIVITY AND NORTH-SOUTH ASYMMETRY OF COSMIC RAYS CIRCA 1 Gv Final Report, 1 Mar. 1977 - 30 Sep. 1984
John T. Ely and Tsai C. Huang 26 Sep. 1986 9 p
(Contract N00014-77-C-0392)
(AD-A174508) Avail: NTIS HC A02/MF A01 CSCL 03/2

Various features of solar sector synchronous modulations of the particulate cosmic radiation reaching the Earth's atmosphere have been studied using satellite and surface data. The flux in the broad maximum of the galactic cosmic ray differential spectrum (near 1 Gv rigidity) exhibits an intermittent north south asymmetry in mid and high geomagnetic latitudes. This modulation exhibited a strong association with geomagnetic disturbance index and interplanetary magnetic field direction during the 1964 and 1965 years of sunspot minimum. Such correlations are consistent with the predictions of a theory that attributes the north south asymmetry to reconnection of the interplanetary and geomagnetic fields. This finding is also consistent with suggestions that solar activity influence on atmospheric processes may be mediated by the resulting modulations of upper trophospheric ionization. GRA

N87-16740# Argonne National Lab., Ill. High Energy Physics Div.
NEW EVIDENCE FROM SOUDAN 1 FOR UNDERGROUND MUONS ASSOCIATED WITH CYGNUS X-3
D. S. Ayres Jun. 1986 5 p Presented at the 2nd Conference on Particle and Nuclear Physics, Lake Louise, Canada, 26 May 1986
(Contract W-31-109-eng-38)
(DE86-014587; ANL-HEP-CP-86-39; CONF-860575-34) Avail: NTIS HC A02/MF A01

The Soudan 1 experiment has obtained additional evidence for underground muons associated with the X-ray pulsar Cygnus X-3. The preliminary analysis of data recorded during the October 1985 radio outburst of Cygnus X-3 is reported, which shows a significant excess of muons for a narrow range of Cygnus X-3 phases. DOE

N87-16741# Texas A&M Univ., College Station.
SEARCH FOR SUPER-HEAVY GUT MAGNETIC MONOPOLES IN COSMIC RAYS Ph.D. Thesis
M. J. Shepko May 1986 78 p
(Contract DE-AS05-81ER-40039)
(DE86-016036; DOE/ER-40039/14) Avail: NTIS HC A05/MF A01

A search for superheavy grand unified theory (GUT) magnetic monopoles has been performed utilizing a large (260 sq m sr) array of scintillation counters, sited underground at a depth of 1200 m.w.e. This apparatus measures both the time of flight and specific ionization of particles passing through it and has a trigger which is sensitive to prompt as well as very slowly developing pulses from the detector. No monopole events have been observed during 280 days of live time operation of this detector. An upper limit on the flux of monopoles of 4.6 x 10 to the -14/sqcm/sr/s is obtained in the velocity range 8.5 x 10 to the -4 to 0.012c at a 90% confidence level. DOE

N87-16704 Ecole Polytechnique, Palaiseau (France). Centre de Physique Theorique.
RADIO EMISSIONS FROM PULSARS
Estelle Asseo *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 425-465 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16706 Observatoire de Paris-Meudon (France).
COMPARATIVE STUDY OF PLANETARY RADIO EMISSIONS
F. Genova *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 477-495 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16708 Observatoire de Paris-Meudon (France).
THEORETICAL DETERMINATION OF THE SPECTRAL INTENSITY OF PLANETARY RADIO EMISSIONS
P. Zarka, D. LeQueau, and F. Genova *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 533-543 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16711 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
FULLY RELATIVISTIC ELECTRON MASERS: A MECHANISM FOR STELLAR RADIO BURSTS
D. LeQueau, P. Louarn, and A. Roux *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 555-562 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16712 Cambridge Univ. (England). Cavendish Lab.
FULL WAVE CALCULATIONS OF RADIO WINDOWS AND THEIR RELEVANCE TO THE THEORY OF PRODUCTION OF PLANETARY NONTHERMAL CONTINUUM RADIATION
K. G. Budden and D. Jones *In* CNES Proceedings of a Conference on the Comparative Study of Magnetospheric Systems 1986 p 563-580 (For primary document see N87-16670 08-88)
Avail: CEPADUES-Editions, Toulouse, France

N87-16783*# Alabama Univ., Birmingham. Dept. of Physics.
SOME ATMOSPHERIC SCATTERING CONSIDERATIONS RELEVANT TO BATSE: A MODEL CALCULATION
John H. Young *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 03B

99 GENERAL

N87-16742*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH REPORTS: 1986 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
L. Michael Freeman, ed., Fridtjof A. Speer, ed., Ernestine K. Cothran, ed., and Gerald R. Karr, ed. Nov. 1986 1022 p Program held in Huntsville, Ala., 27 May - 1 Aug. 1986 Prepared in cooperation with Alabama Univ., Huntsville and Alabama Univ., Tuscaloosa
(Grant NGT-01-002-099)
(NASA-CR-178966; NAS 1.26:178966) Avail: NTIS HC A99/MF E04 CSCL 05A

For the 22th consecutive year, a NASA/ASEE Summer Faculty Fellowship Program was conducted for the summer of 1986 by the University of Alabama and Marshall Space Flight Center. The basic objectives of the program are: (1)to further the professional knowledge of qualified engineering and science faculty members; (2)to stimulate an exchange of ideas between participants and NASA; (3)to enrich and refresh the research and teaching activities of the participants' institution; and (4)to contribute to the research objectives of the NASA center. The Faculty Fellows spent ten weeks at MSFC engaged in a research project compatible with their interest and background and worked in collaboration with a NASA/MSFC colleague. This is a compilation of Fellows' reports on their research. For individual titles, see N87-16743 through N87-16783.

N87-16743*# Furman Univ., Greenville, S.C. Dept. of Computer Science.
IMPLEMENTATION OF A DATA MANAGEMENT SOFTWARE SYSTEM FOR SSME TEST HISTORY DATA c61
Kenneth Abernethy *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 15 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

The implementation of a software system for managing Space Shuttle Main Engine (SSME) test/flight historical data is presented. The software system uses the database management system RIM7 for primary data storage and routine data management, but includes several FORTRAN programs, described here, which provide customized access to the RIM7 database. The consolidation, modification, and transfer of data from the database THIST, to the RIM7 database THISRM is discussed. The RIM7 utility modules for generating some standard reports from THISRM and performing some routine updating and maintenance are briefly described. The FORTRAN accessing programs described include programs for initial loading of large data sets into the database, capturing data from files for database inclusion, and producing specialized statistical reports which cannot be provided by the RIM7 report generator utility. An expert system tutorial, constructed using the expert system shell product INSIGHT2, is described. Finally, a potential expert system, which would analyze data in the database, is outlined. This system could use INSIGHT2 as well and would take advantage of RIM7's compatibility with the microcomputer database system RBase 5000. Author

N87-16744*# Missouri Univ., Rolla. Dept. of Physics.
INVESTIGATION OF HARD TARGETS FOR CALIBRATION OF A COHERENT DOPPLER LIDAR SYSTEM c36
Richard Anderson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 32 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20E

The bihemispherical reflectance has been measured for a diffuse gold surface the same as the coating on the integrating sphere, flowers of sulfur, sandblasted aluminum, and 120 grade aluminum oxide sandpaper. The sandpaper measurements indicate that materials with low reflectance cannot be measured until more sensitive detection techniques are found. The sphere had to be used without a detector baffle so an unusual geometry was needed that led to a loss of intensity. Further, it is estimated that some first-strike light entered the detector and the readings could be 1 to 1.5% too low. A limited number of normal incident directional-hemispherical reflectance measurements were made on aluminum and sandpaper. Several recommendations are made: (1) the proper baffle placement; (2) improve lock-in detection using a PAR lock-in amplifier or the heterodyne technique; (3) modification of the sphere so the sample may be mounted at the cell center on a graduate, rotatable table for measurement of directional-hemispherical reflectance; (4) the purchase of additional diffuse gold samples with coatings like the sphere; and (5) better laser temperature control to improve intensity stability. Author

N87-16745*# Alabama Univ., Birmingham. Dept. of Materials Engineering.
LOW GRAVITY CONTAINERLESS PROCESSING OF IMMISCIBLE GOLD RHODIUM ALLOYS c39
J. Barry Andrews *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20K

Under normal one-g conditions immiscible alloys segregate extensively during solidification due to sedementation of the more dense of the immiscible liquid phases. However, under low-g conditions it should be possible to form a dispersion of the two immiscible liquids and maintain this dispersed structure during solidification. Immiscible (hypermonotectic) gold-rhodium alloys were processed in the Marshall Space Flight Center 105 meter drop tube in order to investigate the influence of low gravity, containerless solidification on their microstructure. Hypermonotectic alloys composed of 65 atomic % rhodium exhibited a tendency for the gold rich liquid to wet the outer surface of the containerless processed samples. This tendency led to extensive segregation in several cases. However, well dispersed microstructures consisting of 2 to 3 micron diameter rhodium-rich spheres in a gold-rich matrix were produced in 23.4 atomic % rhodium alloys. This is one of the best dispersions obtained in research on immiscible alloy-systems to data. Author

N87-16746*# Alabama Univ., Birmingham. Dept. of Materials Engineering.
GROWTH AND CHARACTERIZATION OF Hg(1-x)Zn(x)Se c26
R. N. Andrews *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 48 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 11F

Hg sub 1-xZn sub xSe alloys of composition x=0.10 were grown in a Bridgman-Stockbarger growth furnace at translation rates of 0.3 and 0.1 micron sec. The axial and radial composition profiles were determined using precision density measurements and IR transmission-edge-mapping, respectively. A more radially homogeneous alloy was produced at the slower growth rate, while the faster growth rate produced more axially homogeneous alloys. A determination of the electrical properties of the Hg sub 1-xZn sub xSe samples in the temperature range 300K-20K was also made. Typical carrier concentrations were on the order of magnitude of 10 to the 18th power cu/cm, and remained fairly constant as a function of temperature. A study was also made of the temperature dependence of the resistivity and Hall mobility. The effect of annealing in a selenium vapor on both the IR transmission and the electrical properties was determined. Annealing was effective in reducing the number of native donor defects and at the resulting lower carrier concentrations, charge carrier concentration was shown to be a function of temperature. Annealing caused the mobility to increase, primarily at the lower temperature, and the room temperature resistivity to increase. Annealing was also observed to greatly enhance the % IR transmittance of the samples. This was due primarily to the effect of annealing on decreasing the charge carrier concentration.
Author

N87-16747*# Rice Univ., Houston, Tex. Dept. of Physics.
SOME CONSIDERATIONS ON MEASURING THE NEWTONIAN GRAVITATIONAL CONSTANT G IN AN ORBITING LABORATORY c70
Stephen D. Baker *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 17 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20C

A common suggestion for measuring the Newtonian gravitational constant G in a near-earth orbiting laboratory is simply to put two balls in orbit around each other and observe the resulting motion, thereby determining G. However, the radial variation with distance of the gravitational field of the earth is so large that tidal forces on the balls in near-earth orbit can be several times greater than the gravitational attraction between the two masses, leading some writers to assume that two objects will not stably orbit about each other and that this method of measuring G in low-earth is impossible, or at least impractical. Certain orbits were identified which are stable (at least over many periods of the spacecraft about the earth). In this case, the objects experience their gravitational interaction for a long time, and it becomes reasonable to consider such orbits as candidates for measurements of G.
Author

N87-16748*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
ADVANCED THERMAL ENERGY MANAGEMENT: A THERMAL TEST BED AND HEAT PIPE SIMULATION c34
Ronald G. Barile *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program

Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

Work initiated on a common-module thermal test simulation was continued, and a second project on heat pipe simulation was begun. The test bed, constructed from surplus Skylab equipment, was modeled and solved for various thermal load and flow conditions. Low thermal load caused the radiator fluid, Coolanol 25, to thicken due to its temperature avoided by using a regenera tor-heat-exchanger. Other possible solutions modeled include a radiator heater and shunting heat from the central thermal bus to the radiator. Also, module air temperature can become excessive with high avionics load. A second preoject concerning advanced heat pipe concepts was initiated. A program was written which calculates fluid physical properties, liquid and vapor pressure in the evaporator and condenser, fluid flow rates, and thermal flux. The program is directed to evaluating newer heat pipe wicks and geometries, especially water in an artery surrounded by six vapor channels. Effects of temperature, groove and slot dimensions, and wick properties are reported. Author

N87-16749*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
OPERATIONS PLANNING AND ANALYSIS HANDBOOK FOR NASA/MSFC PHASE B DEVELOPMENT PROJECTS c81
Robert C. Batson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer FAculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 05A

Current operations planning and analysis practices on NASA/MSFC Phase B projects were investigated with the objectives of (1) formalizing these practices into a handbook and (2) suggesting improvements. The study focused on how Science and Engineering (S&E) Operational Personnel support Program Development (PD) Task Teams. The intimate relationship between systems engineering and operations analysis was examined. Methods identified for use by operations analysts during Phase B include functional analysis, interface analysis methods to calculate/allocate such criteria as reliability, Maintainability, and operations and support cost. Author

N87-16750*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
CHARACTERIZATION OF ELASTOMERIC MATERIALS WITH APPLICATION TO DESIGN c27
Mark V. Bower *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)
Avil: NTIS HC A99/MF E04 CSCL 11C

Redesign of the Space Shuttle Solid Booster has necessitated re-evaluation of the material used in the field joint O-ring seals. The viscoelastic characteristics of five candidate materials were determined. The five materials are: two fluorocarbon compounds, two nitrile compounds, and a silicon compound. The materials were tested in a uniaxial compression test to determine the characteristic relaxation functions. These tests were performed at five different temperatures. A master material curve was developed for each material from the experimental data. The results are compared to tensile relaxation tests. Application of these results to the design analysis is discussed in detail. Author

N87-16751*# Miami Univ., Fla. Div. of Meteorology and Physical Oceanography.
A SIMPLE MODEL FOR THE INTERACTION OF PLANETARY AND SYNOPTIC-SCALE WAVES IN THE TROPOSPHERE c46
Lee E. Branscome *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 04A

The time-mean circulation of the troposphere during the Northern hemisphere winter is dominated by planetary-scale stationary waves superposed on longitudinal-mean westerly flow. The movement and generation of weather-making, synoptic-scale transient waves are controlled by this large-scale circulation. The interannual variablity of planetary scale waves determines the severity of the winter season over broad geographic regions through such factors as frequency of storms, precipitation and temperature. A conceptual model that incorporates these feedbacks between the two scales is developed and guides the formulation of the quantitative low-order model which retains a few basic physical processes and wave components. In the low-order model the fluxes of sensible heat and momentum and latent heat release by transient eddies are parameterized in terms of the evolving large-scale circulation. Radiative forcing and damping, planetary-scale variations in moisture and topography and Ekman dissipation are also included. Testing of this model is in progress. The results will help interpret experiments from sophisticated general-circulation models and ascertain the need for satellite observations of precipitation. Author

N87-16752*# DePauw Univ., Greencastle, Ind. Dept. of Physics and Astronomy.
QUANTITATIVE SCHLIEREN ANALYSIS APPLIED TO HOLOGRAMS OF CRYSTALS GROWN ON SPACELAB 3 c35
Howard L. Brooks *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14E

In order to extract additional information about crystals grown in the microgravity environment of Spacelab, a quantitative schlieren analysis technique was developed for use in a Holography Ground System of the Fluid Experiment System. Utilizing the Unidex position controller, it was possible to measure deviation angles produced by refractive index gradients of 0.5 milliradians. Additionally, refractive index gradient maps for any recorded time during the crystal growth were drawn and used to create solute concentration maps for the environment around the crystal. The technique was applied to flight holograms of Cell 204 of the Fluid Experiment System that were recorded during the Spacelab 3 mission on STS 51B. A triglycine sulfate crystal was grown under isothermal conditions in the cell and the data gathered with the quantitative schlieren analysis technique is consistent with a diffusion limited growth process. Author

N87-16753*# Tuskegee Inst., Ala. Dept. of Electrical Engineering.
INVESTIGATION OF POTENTIAL DRIVER MODULES AND TRANSMISSION LINES FOR A HIGH FREQUENCY POWER SYSTEM ON THE SPACE STATION c20
Harold T. Brush *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 35 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 10B

The feasibility of using Series Resonant Inverter as the driver module for high frequency power system on the Space Station was assessed. The performance of the Series Resonant Inverter that was used in the testing of the single-phase, 2.0-kw resonant AC power system breadboard is summarized. The architecture is described and the driver modules of the 5.0 kw AC power system breadboard are analyzed. An investigation of the various types of transmission lines is continued. Measurements of equivalent series resistor and inductor and equivalent parallel capacitors are presented. In particular, a simplified approach is utilized to describe the optimal transmission line. Author

N87-16754*# Alabama Univ., Huntsville. Dept. of Physics and Astronomy.
HOW ARE QUASARS FUELED? SIMULATING INTERSTELLAR GAS IN TIDALLY DISTURBED GALAXIES c90
Gene G. Byrd *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 03B

Whether gravitational tides from companions trigger global instabilities in spiral galaxy disks and thus rapid flows of gas into the nucleus to fuel activity is investigated. An n-body computer

program is used to simulate the disk of the spiral galaxy within a much more stable, high-velocity dispersion spherical halo. Under sufficient perturbation, the disk undergoes violent distortions due to the disturber and its self-gravitation. The tidal action of companions was simulated and the tidal strengths at which the instabilities appear to match those of the observed companions of Seyferts and quasars was shown. With the additional modifications planned, the gas flow will be more realistically simulated to compare with observations (e.g., colors, velocity fields) of active galaxies. Author

N87-16755*# Tennessee Univ., Martin. School of Engineering Technology and Engineering.

AUTONOMOUSLY MANAGED ELECTRICAL POWER SYSTEMS **c33**

Charles P. Callis *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09C

The electric power systems for future spacecraft such as the Space Station will necessarily be more sophisticated and will exhibit more nearly autonomous operation than earlier spacecraft. These new power systems will be more reliable and flexible than their predecessors offering greater utility to the users. Automation approaches implemented on various power system breadboards are investigated. These breadboards include the Hubble Space Telescope power system test bed, the Common Module Power Management and Distribution system breadboard, the Autonomously Managed Power System (AMPS) breadboard, and the 20 kilohertz power system breadboard. Particular attention is given to the AMPS breadboard. Future plans for these breadboards including the employment of artificial intelligence techniques are addressed. Author

N87-16756*# Marshall Univ., Huntington, W. Va. Dept. of Chemistry.

DEVELOPMENT OF PASSIVE RADIATION DETECTORS OF IMPROVED SENSITIVITY **c35**

M. R. Chakrabarty *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

The future development of a solid track high energy particle detector is discussed. The goal is to improve the sensitivity and lower the threshold of the detector. One most widely used material for such purpose is a plastic commercially known as CR-39. A scheme is presented which involves changing the formula of the monomer, diethylene glycol-bis-allyl carbonate. This is to be accomplished by substituting some heteroatoms for H and substituting sulfur atoms for oxygen in the ether linkages. Use of a new plasticizer to make the etched surface clearer than what has been accomplished as of today is suggested. Possible improvement in acquiring better tracks and increasing the ratio of V sub T/V sub B was planned. This is to be accomplished by changing the composition of the etchants, etching time, and etching temperature. Author

N87-16757*# Tennessee Univ. Space Inst., Tullahoma.

COMPUTATION OF NOZZLE FLOW FIELDS USING THE PARC2D NAVIER-STOKES CODE **c34**

Frank G. Collins *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

Supersonic nozzles which operate at low Reynolds numbers and have large expansion ratios have very thick boundary layers at their exit. This leads to a very strong viscous/inviscid interaction upon the flow within the nozzle and the traditional nozzle design techniques which correct the inviscid core with a boundary layer displacement do not accurately predict the nozzle exit conditions. A full Navier-Stokes code (PARC2D) was used to compute the nozzle flow field. Grids were generated using the interactive grid generator code TBGG. All computations were made on the NASA MSFC CRAY X-MP computer. Comparison was made between the computations and in-house wall pressure measurements for CO2 flow through a conical nozzle having an area ratio of 40. Satisfactory agreement existed between the computations and measurements for a stagnation pressure of 29.4 psia and stagnation temperature of 1060 R. However, agreement did not exist at a stagnation pressure of 7.4 psia. Several reasons for the lack of agreement are possible. The computational code assumed a constant gas gamma whereas gamma for CO2 varied from 1.22 in the plenum chamber to 1.38 at the nozzle exit. Finally, it is possible that condensation occurred during the expansion at the lower stagnation pressure. Author

N87-16758*# Texas A&M Univ., College Station. Dept. of meteorology.

NUMERICAL MODELING OF WATER-VAPOR TRANSPORT DURING PRE-STORM AND COHMEX **c46**

Dusan Djuric *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avil: NTIS HC A99/MF E04 CSCL 04A

Initial conditions are designed for numerical simulation of mesocale processes in the atmosphere using the Limited Area Mesoscale Prediction System (LAMPS) model. These initial conditions represent an idealized baroclinic wave in which the transport of water vapor can be simulated. The constructed atmosphere has two homogeneous air masses, polar front, polar jet stream and a stratosphere. All these simulate the basic structure of the earth's atmosphere. The hydrostatic and geostrophic balances make it possible to evaluate mutually consistent fields of wind and of the height of isobaric surfaces. Author

N87-16759*# John Brown Univ., Siloam Springs, Ark. Dept. of Mechanical Engineering.

THEORETICAL STUDIES ON THE MECHANICAL BEHAVIOR OF GRANULAR MATERIALS UNDER VERY LOW INTERGRANULAR STRESSES **c39**

Kenneth W. French, Jr. *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20K

The salient aspects of the theoretical modeling of a conventional triaxial test (CTC) of a cohesionless granular medium with stress and strain rate loading are described. Included are a controllable gravitational body force and provision for low confining pressure and/or very low intergranular stress. The modeling includes rational, analytic, and numerical phases, all in various stages of development. The numerical evolutions of theoretical models will be used in final design stages and in the analysis of the experimental data. In this the experimental design stage, it is of special interest to include in the candidate considerations every anomaly found in preliminary terrestrial experimentation. Most of the anomalies will be eliminated by design or enhanced for measurement as the project progresses. The main aspect of design being not the physical apparatus but the type and trajectories of loading elected. The major considerations that have been treated are: appearance and growth of local surface aberrations, stress-power coefficients, strain types, optical strain, radial bead migration, and measures of rotation for the proper stress flux. Author

N87-16760*# Georgia Univ., Athens. Dept. of Geology.

A STUDY OF THE POSSIBLE EFFECT OF A THERMAL POST CURE ON THE MECHANICAL PROPERTIES OF THE 404 CARBON-PHENOLIC RING OF THE SPACE SHUTTLE SOLID ROCKET MOTOR NOZZLE **c20**

A. A. Giardini *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 24 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 21H

Erratic pockets of erosion have occurred on the inner perimeter of the 404 rocket nozzle ring during liftoff firing. It is thought that

it may be caused by pockets of volatile matter entrapped during manufacture. A thermal post cure was suggested as a possible means of outgassing such pockets, if they in fact do exist. To confirm an outgassing during a post cure and to establish a working upper temperature limit, thermal gravimetric and differential calorimetric analyses were made on a number of samples from two 404 rings supplied by the manufacturer. Continuous weight loss was observed over the temperature range expiored (750 F) indicating outgassing, and a strong exothermic reaction occurs beginning about 390 F. Thus, an upper post cure temperature of 350 F is recommended. To determine the possible effect of a post cure on physical properties, the following tests will be made on matched sets of cured and post cured material: x-radiography (internal structure), linear dimensions, weight, porosity, cross ply thermal expansion, drop and double notch shear strengths, and tensional strength in the ply direction. Author

N87-16761*# Oakwood Coll., Huntsville, Ala. Dept. of Business and Information Systems Management.
AN EVALUATION OF THE DOCUMENTED REQUIREMENTS OF THE SSP UIL AND A REVIEW OF COMMERCIAL SOFTWARE PACKAGES FOR THE DEVELOPMENT AND TESTING OF UIL PROTOTYPES **c61**
Esther Naomi Gill *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 36 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

A review was conducted of software packages currently on the market which might be integrated with the interface language and aid in reaching the objectives of customization, standardization, transparency, reliability, maintainability, language substitutions, expandability, portability, and flexibility. Recommendations are given for best choices in hardware and software acquisition for inhouse testing of these possible integrations. Software acquisition in the line of tools to aid expert-system development and/or novice program development, artificial intelligent voice technology and touch screen or joystick or mouse utilization as well as networking were recommended. Other recommendations concerned using the language Ada for the user interface language shell because of its high level of standardization, structure, and ability to accept and execute programs written in other programming languages, its DOD ownership and control, and keeping the user interface language simple so that multiples of users will find the commercialization of space within their realm of possibility which is, after all, the purpose of the Space Station. Author

N87-16762*# Jackson State Univ., Miss. Dept. of Mathematics.
STRATIFIED PROCESSES TO ANALYZE SSME PARTS AND SUBSYSTEMS USING WEIBULL METHODOLOGY **c65**
Lou Allen Bell Gray *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14D

Due to the various parts found in a Space Shuttle Main Engine (SSME), analyzation of every part is not feasible or needed. Based on previous mathematical modeling experience of high velocity cryogenic equipment, the environmental traits of location of the part, temperature range, fluid velocity, pressure range, and elevation variation of fluid flow as being significant factors were determined. Six parts categories were developed. The part categories are: (1) fuel turbomachinery, (2) oxidizer, (3) combustion devices, (4) valves, (5) ducts, and (6) lines. Due to a suspicion that superficial failure modes exist, six status codes were developed. The codes are: (1) part is in service presently, (2) part is out-of-service due to its own failure, (3) part is out-of-service due to engine (or some other part failure), (4) part is out-of-service because it's retired/obsolete (time related), (5) never fired-scrapped due to own problem or part is store, and (6) part is out-of-service for repair. It was suggested that to properly model failure behavior of SSME parts that: (1) significant factors contributing to failure must be examined, (2) relatively precision based on real life data must be examined, and (3) alternative definitions of failure must be initialized by the engineers. Author

N87-16763*# University of Southern Mississippi, Hattiesburg. Dept. of Engineering Technology.
DEVELOPMENT OF AUTOMATED ELECTROMAGNETIC COMPATIBILITY TEST FACILITIES AT MARSHALL SPACE FLIGHT CENTER **c09**
Cecil A. Harrison *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 17 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

The efforts to automate the electromagentic compatibility (EMC) test facilites at Marshall Flight Center were examined. A battery of nine standard tests is to be integrated by means of a desktop computer-controller in order to provide near real-time data assessment, store the data acquired during testing on flexible disk, and provide computer production of the certification report. Author

N87-16764*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
INVERSION LAYER MOS SOLAR CELLS **c44**
Fat Duen Ho *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 10A

Inversion layer (IL) Metal Oxide Semiconductor (MOS) solar cells were fabricated. The fabrication technique and problems are discussed. A plan for modeling IL cells is presented. Future work in this area is addressed. Author

N87-16765*# Louisiana Tech Univ., Ruston. Dept. of Mechanical Engineering.
ELIMINATION SEQUENCE OPTIMIZATION FOR SPAR **c61**
Harry A. Hogan *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 23 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

SPAR is a large-scale computer program for finite element structural analysis. The program allows user specification of the order in which the joints of a structure are to be eliminated since this order can have significant influence over solution performance, in terms of both storage requirements and computer time. An efficient elimination sequence can improve performance by over 50% for some problems. Obtaining such sequences, however, requires the expertise of an experienced user and can take hours of tedious effort to affect. Thus, an automatic elimination sequence optimizer would enhance productivity by reducing the analysts' problem definition time and by lowering computer costs. Two possible methods for automating the elimination sequence specifications were examined. Several algorithms based on the graph theory representations of sparse matrices were studied with mixed results. Significant improvement in the program performance was achieved, but sequencing by an experienced user still yields substantially better results. The initial results provide encouraging evidence that the potential benefits of such an automatic sequencer would be well worth the effort. Author

N87-16766*# Alabama Univ., Huntsville. Dept. of Mathematics.
STOCHASTIC MODELING AND CONTROL SYSTEM DESIGNS OF THE NASA/MSFC GROUND FACILITY FOR LARGE SPACE STRUCTURES: THE MAXIMUM ENTROPY/OPTIMAL PROJECTION APPROACH **c18**
Wei-Shen Hsia *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 13 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22B

In the Control Systems Division of the Systems Dynamics Laboratory of the NASA/MSFC, a Ground Facility (GF), in which the dynamics and control system concepts being considered for Large Space Structures (LSS) applications can be verified, was designed and built. One of the important aspects of the GF is to design an analytical model which will be as close to experimental

data as possible so that a feasible control law can be generated. Using Hyland's Maximum Entropy/Optimal Projection Approach, a procedure was developed in which the maximum entropy principle is used for stochastic modeling and the optimal projection technique is used for a reduced-order dynamic compensator design for a high-order plant. Author

N87-16767*# Auburn Univ., Ala. Dept. of Materials Engineering.
WELD RADIOGRAPH ENIGMAS c37
Wartan A. Jemian *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

Weld radiograph enigmas are features observed on X-ray radiographs of welds. Some of these features resemble indications of weld defects, although their origin is different. Since they are not understood, they are a source of concern. There is a need to identify their causes and especially to measure their effect on weld mechanical properties. A method is proposed whereby the enigmas can be evaluated and rated, in relation to the full spectrum of weld radiograph indications. This method involves a signature and a magnitude that can be used as a quantitive parameter. The signature is generated as the diference between the microdensitometer trace across the radiograph and the computed film intensity derived from a thickness scan along the corresponding region of the sample. The magnitude is the measured difference in intensity between the peak and base line values of the signature. The procedure is demonstated by comparing traces across radiographs of a weld sample before and after the introduction of a hole and by a system based on a MacIntosh mouse used for surface profiling. Author

N87-16768*# Huntingdon Coll., Montgomery, Ala. Dept. of Chemistry.
DEVELOPMENT OF AC IMPEDANCE METHODS FOR EVALUATING CORRODING METAL SURFACES AND COATINGS c25
Ward Knockemus *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 25 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 07D

In an effort to investigate metal surface corrosion and the breakdown of metal protective coatings the AC Impedance Method was applied to zinc chromate primer coated 2219-T87 aluminum. The model 368-1 AC Impedance Measurement System recently acquired by the MSFC Corrosion Research Branch was used to monitor changing properties of coated aluminum disks immersed in 3.5% NaCl buffered at ph 5.5 over three to four weeks. The DC polarization resistance runs were performed on the same samples. The corrosion system can be represented by an electronic analog called an equivalent circuit that consists of transistors and capacitors in specific arrangements. This equivalent circuit parallels the impedance behavior of the corrosion system during a frequency scan. Values for resistances and capacities that can be assigned in the equivalent circuit following a least squares analysis of the data describe changes that occur on the corroding metal surface and in the protective coating. A suitable equivalent circuit was determined that predicts the correct Bode phase and magnitude for the experimental sample. The DC corrosion current density data are related to equivalent circuit element parameters. Author

N87-16769*# New Mexico State Univ., University Park.
BENCHMARKS OF PROGRAMMING LANGUAGES FOR SPECIAL PURPOSES IN THE SPACE STATION c61
Arthur Knoebel *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 29 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

Although Ada is likely to be chosen as the principal programming language for the Space Station, certain needs, such as expert systems and robotics, may be better developed in special languages. The languages, LISP and Prolog, are studied and some benchmarks derived. The mathematical foundations for these languages are reviewed. Likely areas of the space station are sought out where automation and robotics might be applicable. Benchmarks are designed which are functional, mathematical, relational, and expert in nature. The coding will depend on the particular versions of the languages which become available for testing. Author

N87-16770*# Mississippi State Univ., State College. Dept. of Physics and Astronomy.
IN SEARCH OF STRATOSPHERIC BROMINE OXIDE c46
John Patrick Lestrade *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 04A

The Imaging Spectrometric Observatory (ISO) is capable of recording spectra in the wavelength range of 200 to 12000 Angstroms. Data from a recent Spacelab 1 ATLAS mission has imaged the terrestrial airglow at tangent ray heights of 90 and 150 km. These data contain information about trace atmospheric constituents such as bromine oxide (BrO), hydroxyl (OH), and chlorine dioxide (OClO). The abundances of these species are critical to stratospheric models of catalytic ozone destruction. Heretofore, very few observations were made especially for BrO. Software was developed to purge unwanted solar features from the airglow spectra. The next step is a measure of the strength of the emission features for BrO. The final analysis will yield the scale height of this important compound. Author

N87-16771*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
ANALYTICAL FORMULATION OF ORBITER-PAYLOAD COUPLED BY TRUNNION JOINTS WITH COULOMB FRICTION c37
Frank C. Liu *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 35 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

An orbiter and its payload substructure are linked together by five trunnion joints which have thirty degrees-of-freedom. Geometric compatibility conditions require fourteen of the interface physical coordinates of the orbiter and payload to be equal to each other and the remaining sixteen are free to have relative motions under Coulomb friction. The component modes synthesis method using fourteen inertia relief attachment modes for the formulation of the coupled system is presented. The exact nonlinear friction function is derived based on the characteristics of the joints. Formulation is applicable to an orbiter that carries any number of payload substructures. Author

N87-16772*# Berry Coll., Mount Berry, Ga. Dept. of Physics.
A STUDY OF RADAR CROSS SECTION MEASUREMENT TECHNIQUES c32
Malcolm W. McDonald *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 22 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 17I

Past, present, and proposed future technologies for the measurement of radar cross section were studied. The purpose was to determine which method(s) could most advantageously be implemented in the large microwave anechoic chamber facility which is operated at the antenna test range site. The progression toward performing radar cross section measurements of space vehicles with which the Orbital Maneuvering Vehicle will be called upon to rendezvous and dock is a natural outgrowth of previous work conducted in recent years of developing a high accuracy range and velocity sensing radar system. The radar system was designed to support the rendezvous and docking of the Orbital Maneuvering Vehicle with various other space vehicles. The measurement of radar cross sections of space vehicles will be necessary in order to plan properly for Orbital Maneuvering Vehicle rendezvous and docking assignments. The methods which were

studied include: standard far-field measurements; reflector-type compact range measurements; lens-type compact range measurement; near field/far field transformations; and computer predictive modeling. The feasibility of each approach is examined. Author

N87-16773*# Athens Coll., Ala. Dept. of Chemistry.
EVALUATION OF MOISTURE BARRIER COATINGS ON CARBON-PHENOLIC SRM NOZZLE MATERIALS c20
Ronald C. McNutt *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 19 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 21H

The carbon-phenolic composite ablative material used on the Solid Rocket Motor (SRM) nozzle is known to absorb moisture from the atmosphere. This could cause problems such as pocketing during firing. Several moisture barrier coatings were tested on the SRM nozzle material. Data are presented for six of the 12 coatings to be tested. The data were obtained from immersion of coated samples in an environmental chamber at 100 F and 100% relative humidity and by using a modified TGA (thermal gravimetric analysis) technique. The TGA technique involved allowing wet nitrogen (25 C, 80% relative humidity) to flow across a small sample at about 65 cu cm per minute while continually monitoring the weight increase. These preliminary results show Kel-F-800, a material supplied by 3M Corporation to be the better moisture barrier. A second task was to collect data on the relative absorption of water and kerosene into the carbon-phenolic SRM nozzle material. These data indicate that water absorbs into the nozzle material to a much greater extent than kerosene. Thus kerosene is the more likely solvent in which to make specific gravity measurements on the SRM nozzle material. Author

N87-16774*# Washington and Lee Univ., Lexington, Va. Dept. of Physics.
MODIFICATIONS OF THE X-RAY SOURCE AND MONITOR AT THE X-RAY CALIBRATION FACILITY c09
W. Barlow Newbolt *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 18 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

In order to test the instruments aboard the Advanced X-ray Astrophysics Facility (AXAF) some modifications will need to be made in the X-ray Calibration Facility at Marshall. Several of these modifications involve the X-ray source and the monitor. The source was redesigned to increase the spectral purity of the beam and decrease its polarization by minimizing the number of bremsstrahlung photons in the beam. This was accomplished by utilizing an annular electron gun which allowed the beam to take off antiparallel to the direction at which electrons are incident on the anode. Two other features of the source are the conical anode which decreases the effective spot size and a rotatable anode and filter wheel which allow the operator to change targets without breaking vacuum. The monitor is an important part of the facility because it is used to determine the X-ray flux at the target. A commercially available solid-state detector, Si(Li), should be used along with appropriate proportional counters for monitoring. This detector will be particularly useful when energy or wavelength dispersive instruments are tested because of its good resolution. Author

N87-16775*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
COMPUTER-AIDED ANALYSIS FOR THE MECHANICS OF GRANULAR MATERIALS (MGM) EXPERIMENT c29
Joey K. Parker *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 24 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22A

The Mechanics of Granular Materials (MGM) program is planned to provide experimental determinations of the mechanics of granular materials under very low gravity conditions. The initial experiments will use small glass beads as the granular material, and a precise tracking of individual beads during the test is desired. Real-time video images of the experimental specimen were taken with a television camera, and subsequently digitized by a frame grabber installed in a microcomputer. Easily identified red tracer beads were randomly scattered throughout the test specimen. A set of Pascal programs was written for processing and analyzing the digitized images. Filtering the image with Laplacian, dilation, and blurring filters when using a threshold function produced a binary (black on white) image which clearly identified the red beads. The centroids and areas for each bead were then determined. Analyzing a series of the images determined individual red bead displacements throughout the experiment. The system can provide displacement accuracies on the order of 0.5 to 1 pixel is the image is taken directly from the video camera. Digitizing an image from a video cassette recorder introduces an additional repeatability error of 0.5 to 1 pixel. Other programs were written to provide hardcopy prints of the digitized images on a dot-matrix printer. Author

N87-16776*# Tennessee Technological Univ., Cookeville. Dept. of Matehmatics and Computer Science.
STATISTICAL ANALYSIS OF FAILURE DATA ON CONTROLLERS AND SSME TURBINE BLADE FAILURES c38
S. A. Patil *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 27 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14D

The expressions for the maximum likelihood functions are given when the failure data are censored at a given point or at multiple points, or when the data come in groups. Different models applicable to failure data are presented with their characteristics. A graphical method of distinguishing different models by using cumulative hazard function is discussed. For the failure data on controllers the model is determined by cumulative hazard function and chi-square goodness of fit. Using the Weibull Model the maximum likelihood estimators of the shape parameter and the failure rate parameter are obtained. The confidence intervals, meantime between failures, and B1 are determined. Similarly, for the data on Space Shuttle Main Engine (SSME) blade failures the maximum likelihood estimators are obtained for the Weibull parameters. The variances, confidence intervals, meantime between failures, and reliability are determined. The analysis is performed under assumption of grouped data as well as randomly placed data. Author

N87-16777*# Pennsylvania Univ., Philadelphia. Dept. of Systems.
MANAGEMENT OF SSME HARDWARE LIFE UTILIZATION c20
J. M. Pauschke *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 30 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 21H

Statistical and probabilistic reliability methodologies were developed for the determination of hardware life limits for the Space Shuttle Main Engine (SSME). Both methodologies require that a mathematical reliability model of the engine (system) performance be developed as a function of the reliabilities of the components and parts. The system reliability model should be developed from the Failute Modes and Effects Analysis/Critical Items List. The statistical reliability methodology establishes hardware life limits directly from the failure distributions of the components and parts obtained from statistically-designed testing. The probabilistic reliability methodology establishes hardware life limits from a decision analysis methodology which incorporates the component/part reliabilities obtained from a probabilistic structural analysis, a calibrated maintenance program, inspection techniques, and fabrication procedures. Probilistic structural analysis is recommended as a tool to prioritize upgrading of the components and parts. The Weibull probability distribution is presently being investigated by NASA/MSFC to characterize the failure distribution of the SSME hardware from a limited data base of failures.

N87-16778*# Alabama Univ., Huntsville. Dept. of Computer Science.
APPLICATIONS OF ARTIFICIAL INTELLIGENCE TO SCIENTIFIC RESEARCH **c63**
Mary Ellen Prince *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 20 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 09B

Artificial intelligence (AI) is a growing field which is just beginning to make an impact on disciplines other than computer science. While a number of military and commercial applications were undertaken in recent years, few attempts were made to apply AI techniques to basic scientific research. There is no inherent reason for the discrepancy. The characteristics of the problem, rather than its domain, determines whether or not it is suitable for an AI approach. Expert system, intelligent tutoring systems, and learning programs are examples of theoretical topics which can be applied to certain areas of scientific research. Further research and experimentation should eventurally make it possible for computers to act as intelligent assistants to scientists. Author

N87-16779*# Memphis State Univ., Tenn. Dept. of Mechanical Engineering.
SHARPLEY CURVED TURN AROUND FLOW PREDICTIONS USING SPECTRAL PARTITIONING OF THE TURBULENT KINET IC ENERGY AND A PRESSURE MODIFIED WALL LAW **c34**
L. Michael Santi *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 37 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 20D

Computational predictions of turbulent flow in sharply curved 180 degree turn around ducts are presented. The CNS2D computer code is used to solve the equations of motion for two-dimensional incompressible flows transformed to a nonorthogonal body-fitted coordinate system. This procedure incorporates the pressure velocity correction algorithm SIMPLE-C to iteratively solve a discretized form of the transformed equations. A multiple scale turbulence model based on simplified spectral partitioning is employed to obtain closure. Flow field predictions utilizing the multiple scale model are compared to features predicted by the traditional single scale k-epsilon model. Tuning parameter sensitivities of the multiple scale model applied to turn around duct flows are also determined. In addition, a wall function approach based on a wall law suitable for incompressible turbulent boundary layers under strong adverse pressure gradients is tested. Turn around duct flow characteristics utilizing this modified wall law are presented and compared to results based on a standard wall treatment. Author

N87-16780*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
A STUDY OF BOILING HEAT TRANSFER AS APPLIED TO THE COOLING OF BALL BEARINGS IN THE HIGH PRESSURE OXYGEN TURBOPUMP OF THE SPACE SHUTTLE MAIN ENGINE **c37**
Will Schreiber *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship program Nov. 1986 21 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 13I

Two sets of ball bearings support the main shaft within the High Pressure Oxygen Turbopump (HPOTP) in the Space Shuttle Main Engine (SSME). In operation, these bearings are cooled and lubricated with high pressure liquid oxygen (LOX) flowing axially through the bearing assembly. Currently, modifications in the assembly design are being contemplated in order to enhance the lifetime of the bearings and to allow the HPOTP to operate under larger loads. An understanding of the fluid dynamics and heat transfer characteristics of the flowing LOX is necessary for the implementation of these design changes. The proposed computational model of the LOX fluid dynamics, in addition to dealing with a turbulent flow in a complex geometry, must address the complication associated with boiling and two-phase flow. The feasibility of and possible methods for modeling boiling heat transfer are considered. The theory of boiling as pertains to this particular problem is reviewed. Recommendations are given for experiments which would be necessary to establish validity for correlations needed to model boiling. B.G.

N87-16781*# Tri-State Univ., Angola, Ind. Dept. of Mechanical and Aerospace Engineering.
TETHER CRAWLER SYSTEM **c18**
Frank R. Swanson *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 27 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 22B

A crawler system is designed to move a low-g/variable-g laboratory module along a tether between the Space Station and an attached space platform. An analysis is made of the effects of control law parameter change on the displacement, velocity, and acceleration of the crawler system. The control law is then modified by the addition of a constant-velocity section and the values of distance traveled, velocity, and acceleration are analyzed as a function of time. The power and torque equations are derived for a crawler system moving along a tether in orbit and numerical values of power and torque required for each prescribed movement are calculated versus time for four different cases using the control laws. A two-step control sequence is selected to permit initial location along the tether by distance traveled, followed by a vernier movement to reach the final desired constant net acceleration level. The components for the control system are identified and arranged in a block disgram configuration. The support subsysterns are also identified. The sections were integrated to develop a procedure for the determination of crawler system performance requirements and the initial design of tether crawler systems. B.G.

N87-16782*# Alabama Univ., Huntsville. Dept. of Physics.
AUTOMATED CALIBRATION OF A FLIGHT PARTICLE SPECTROMETER **c35**
Roy B. Torbert *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 12 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 14B

An automatic calibration system was designed for use in the vacuum facility at the Space Science Laboratory of the Marshall Space Flight Center. That system was developed and used in the intervening winter to calibrate the ion spectrometer that eventually flew in May 1986 aboard the NASA project, CRIT 1. During this summer, it is planned to implement the calibration of both an ion and electron spectrometer of a new design whose basic elements were conceived during the winter of 1985 to 1986. This spectrometer was completed in the summer and successfully mounted in the vacuum tank for calibration. However, the source gate valve malfunctioned, and, at the end of the summer, it still needed a replacement. During the inevitable delays in the experimental research, the numerical model of the Critical Velocity effect was completed and these results were presented. Author

N87-16783*# Alabama Univ., Birmingham. Dept. of Physics.
SOME ATMOSPHERIC SCATTERING CONSIDERATIONS RELEVANT TO BATSE: A MODEL CALCULATION **c93**
John H. Young *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program Nov. 1986 26 p (For primary document see N87-16742 08-99)
Avail: NTIS HC A99/MF E04 CSCL 03B

The orbiting Burst and Transient Source Experiement (BATSE) will locate gamma ray burst sources by analysis of the relative numbers of photons coming directly from a source and entering its prescribed array of detectors. In order to accurately locate burst sources it is thus necessary to identify and correct for any counts contributed by events other than direct entry by a mainstream photon. An effort is described which estimates the photon numbers which might be scattered into the BATSE detectors from interactions with the Earth atmosphere. A model was developed which yielded analytical expressions for single-

scatter photon contributions in terms of source and satellite locations. Author

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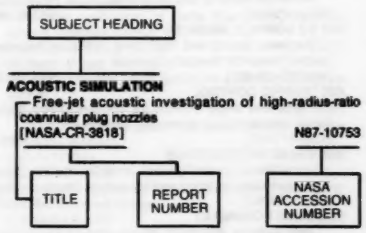

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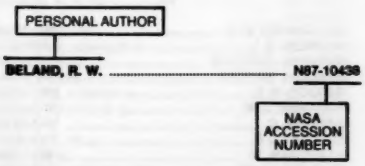

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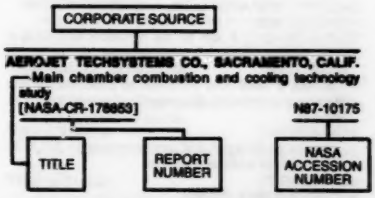

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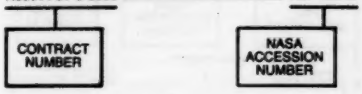

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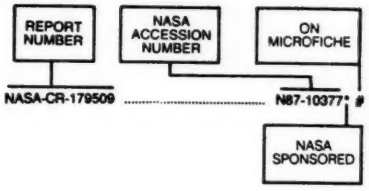

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US-PATENT-4,601,642 ..... N87-16248
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USAAVSCOM-TR-86-C-36 ..... N87-15944* #

USAFETAC/DS-86/001 ..... N87-16488 #

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UVA/525398/MS87/101 ..... N87-16073 #

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